

MEETING MINUTES

Subject: Expedited Response Action Weekly Interface

TO: Distribution

BUILDING: 740 Stevens Building

FROM: W. L. Johnson

CHAIRMAN: G. C. Henckel

Dept-Operation-Component	Area	Shift	Meeting Dates	Number Attending
Environmental Engineering	3000	Day	December 14, 1992	14

Distribution

State of Washington Department of Ecology

J. Donnelly fax
L. Goldstein
D. Goswami
R. L. Hibbard
J. Phillips*
D. D. Teel
N. Uziemblo*
J. Yokel
T. Wooley*

U.S. Army Corps of Engineers

J. T. Stewart A5-20

U.S. Department of Energy, Richland Field Office

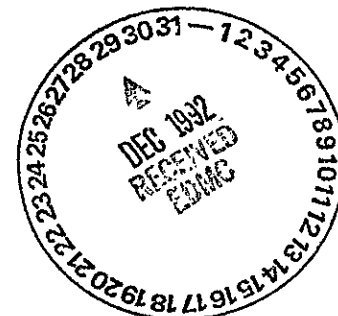
H. L. Chapman A5-19
J. K. Erickson A5-19
E. D. Goller* A5-19
R. G. McLeod A5-19
P. M. Pak A5-19
R. K. Stewart A5-19

U.S. Environmental Protection Agency

P. R. Beaver B5-01
P. T. Day
D. R. Einan
D. A. Faulk*
L. E. Gadbois*
P. S. Innis*
D. R. Sherwood*

Westinghouse Hanford Company

L. D. Arnold B2-35
M. V. Berriochoa B3-30
H. D. Downey H6-27
W. F. Heine B2-35
G. C. Henckel* H6-04
J. K. Patterson* H6-27
D. L. Sickle* H6-27
T. M. Wintczak H6-27
EDMC H4-22
ERAG Route H6-04
GCH File/LB



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*Attendees

The weekly interface meetings on the expedited response actions (ERAs) was held to status the ERAs for the U.S. Department of Energy, Richland Field Office and the regulators. The meeting was conducted in accordance with the attached agenda. Actions were formally reviewed and the attached action item list was updated. The weekly report is also attached.

All eight ERAs were discussed and their status summarized. Approval was given for sampling on the North Slope as documented in the Decisions, Agreements & Commitments form (attached).

The next weekly interface meeting will be held on January 4, 1993, 740 Stevens Building/CR 1200, from 9:30 a.m. to 11:00 p.m. (as before).

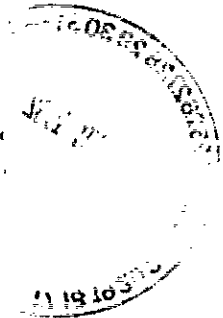
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Distribution
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December 14, 1992

Attachments:

1. Agenda
2. Action Item List
3. Decisions, Agreements & Commitments for North Slope Sampling
4. Expedited Response Action Weekly Report, week ending 12/11/92
5. Ground Penetrating Radar Draft Report for Riverland ERA
6. XRF Information/Data for White Bluffs Pickling Acid Crib ERA
7. N-Springs Draft Schedule
8. Riverland Draft Soil Gas Data

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WEEKLY ERA INTERFACE AGENDA

SUBJECT: STATUS OF THE EXPEDITED RESPONSE ACTIONS

DATE: December 14, 1992

- GENERAL ISSUES
 - ERA Interface Action Item review
- INDIVIDUAL PROJECT STATUS
 - 200-W Carbon Tetrachloride
 - o Site characterization FY 93 document to RL 11/30/92
 - N-Springs
 - o EE/CA has been initiated
 - o 12/28/92 presentation as previous modeling
 - Sodium Dichromate
 - o Public review status began 12/9/92
 - North Slope
 - o Second phase sampling provided to Ecology and EPA 12/3/92
 - o ERA proposal under development
 - Pickling Acid Crib
 - o Sampling completed 12/7/92
 - o Xmet data
 - Riverland
 - o Soil gas results
 - o Draft proposal 1/15/93 pending lab data
 - 618-11
 - o Document work continues
 - o Packaging & transportation
 - 618-9 & 316-5
 - o Closure report status?
- OTHER ISSUE
 - o John Stewart ordinance support letter
- SUMMARY OF ACTION ITEMS
- SIGN-OFF ON ANY DECISIONS, AGREEMENTS, OR COMMITMENTS

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EXPEDITED RESPONSE ACTION INTERFACE MEETING

-ACTION ITEMS-
December 14, 1992

ORGANIZATION

ACTION ITEM

WHC	WHC will provide RL, EPA, and Ecology copies of the GPR reports for the Riverland ERA site when it becomes available. (open) North Slope, Sodium Dichromate, and Pickling Acid reports have been provided. (open)
WHC	Provide description of the best method to incorporate 618-10 into 618-11 ERA. (open)
WHC	Nuclear Safety briefing on the approach to be used for 618-11 ERA when determined. (open)
WHC (revised)	WHC will prepare draft fact sheets on the new ERAs for review. (open)
WHC	Provide a list of wells near 618-11 including depths, locations, and construction logs requested by regulators. (open)
WHC	Provide XRF data for White Bluffs Pickling Acid Crib sampling. (open)
WHC	Status of Riverland schedule. (open)
EPA	Provide information on passive emissions for CCl_4 . (open)
EPA	Provide information on regulator position for an Interim Record of Decision for CCl_4 ERA. (open)
EPA	Develop procedure for inclusion in TPA handbook for transmittal of field information and sample data obtained by regulators during split sampling activities. (open)

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EXPEDITED RESPONSE ACTION INTERFACE MEETING

-DECISIONS, AGREEMENTS, & COMMITMENTS-
December 14, 1992

DECISIONS:

AGREEMENTS: PART 2 SAMPLING AT THE NORTH SLOPE
CAN BEGIN ON 12/14/92

COMMITMENTS:

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for P.S.
12-14-92

DOE Representative

12-14-92

EPA Representative

12/14/92

ECOLOGY Representative

WHC Representative

Weekly Report, Week Ending December 11, 1992
EXPEDITED RESPONSE ACTIONS
Technical and Management Contact - Wayne L. Johnson, 376-1721
Environmental Division

North Slope Expedited Response Action - Regulatory comments concerning the phase II sampling activities were dispositioned, and will be incorporated into the sampling plan. The State of Washington Department of Ecology will approve the sampling plan during the next weekly interface meeting pending incorporation of the comments as dispositioned.

Phase two sampling activities are scheduled to begin the week of December 14, 1992. Preparation of the Expedited Response Action (ERA) proposal continues. Analytical data from the first phase of sampling is arriving. The data is being placed into a data base to allow for interpretation.

N-Springs Expedited Response Action - The preparation of the ERA proposal continues.

White Bluffs Pickling Acid Crib Expedited Response Action - Sampling on the White Bluffs Pickling Acid Crib was completed December 7, 1992.

Riverland Railroad Site Expedited Response Action - Waiting for offsite lab results for the Riverland samples. Work is in process on the Riverland EE/CA.

Sodium Dichromate Expedited Response Action - Sodium Dichromate Engineering Evaluation/Cost Analysis (EE/CA) public comment period (December 8, 1992, through January 7, 1993) has been initiated. A formal notice was printed in the *Tri-City Herald* December 8, 1992.

618-11 Expedited Response Action -

Groundwater Wells - Well depths and locations surrounding the 618-11 Burial Grounds are being researched.

Transportation - A meeting was held with WHC transportation and packaging to enlist their support in developing proposals for the EE/CA.

200 West Carbon Tetrachloride Expedited Response Action - Field work (stabilization of drill sites) is scheduled to begin on December 21, 1992.

Phase 1 of the pipeline assessment work has been put off due to work prioritization issues within PFP (the 216-Z-9 lines require access from PFP). This appears to be a recurring issue. A meeting will be held with PFP management to find a solution to this issue.

Baseline Monitoring - Changes in safety requirements and a lack of equipment prevented baseline monitoring from occurring on December 3, 1992. Equipment is now available and discussions with Health and Safety appear to have solved these difficulties.

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Well Field Design - The draft "FY 1993 Wellfield Enhancement Workplan" has been sent out for internal review. Informal draft copies have been supplied to EPA.

Vapor Extraction System (VES) Operations - GAC Release and Regeneration - Sampling of the Envirotrol activated carbon for radionuclides is scheduled for the week of December 11, 1992. The sampling analysis has been priority requested in order to expedite the work associated with analytical support.

At the same time a sample will be pulled for a SW-846 analysis such that Solid Waste Operations can designate the waste for Department of Transportation shipment.

The radon test plan has been revised and issued. The Radiological Engineering Function is preparing a calibration log for maintenance of the radon detectors. It is thought several of the detectors will be shipped to the manufacturer for recalibration prior to re-initiating operations on January 4, 1993. The calibration log will be the start of a preventive maintenance program for the detectors (and associated Lucas cells).

Envirotrol (the activated carbon regeneration vendor) has expressed concern that no canisters have been returned to them for regeneration. The contract provides payment to Envirotrol after successful regeneration and destruction of the CCl_4 , and since WHC has not sent any canisters to them for regeneration, they have received no payment. Discussions between Envirotrol and Procurement were undertaken to arrive at some equitable arrangement for interim payments.

Current VES Operations - The VES unit was shut down to install flow meters, and to allow personnel to support the planning, engineering, and arrangements for the new VES units. Therefore, there is no production data. A total of 1884 lbs have been removed to date. The system will be down until the first of January 1992 and is planned to be up for 24 hour operations at that time.

24 Hour Operations - It is estimated that 24 hour operations will begin the week of January 4, 1993. A process control system expert will be coming in on December 11, 1992, to help get the process control system setup.

Upgrade Existing System (1000 cfm) - Work is proceeding with procuring and installing necessary equipment (i.e. motors).

Leased 500 cfm Vapor Extraction System (VES) - Bids for leasing the 500 cfm VES unit were received on December 9, 1992. Two of the six initial vendors submitted bids. Technical evaluation of the bids will be completed and returned to Procurement on December 10, 1992.

Final design drawings for fabrication of the HEPA Trailer that will support the leased unit operations will be produced and delivered the fabrication shops December 9, 1992. The trailer and HEPA housing were delivered to the fabrication shop this past week and it is anticipated that fabrication will begin on December 9, 1992.

Design drawings for the Process Control Trailer that will also support the leased unit operations are expected to be completed by December 14, 1992.

Z-9 Operations - Engineering/Operational support services have been procured to supply additional support to the VES team, to meet milestones at Z-9.

Design for the power at Z-9 crib is proceeding. 480V Power will be run overhead to where we need it by setting two poles. A generator is being procured and moved to the disposal facility as an alternate power supply should permanent power not be installed in time to support start-up of the leased system.

A request for services has been submitted to EFS for fabricating and installing the well-head caps. The work is anticipated to be completed by February 1, 1993.

An existing work order to KEH for stabilizing the 216-Z-1A disposal facility has been supplemented to include site stabilization activities at 216-Z-9. These activities are to include leveling, filling, and additional gravel at the parking area.

Onsite Treatment Study - Ebasco services were procured to assist in writing up this study, which is a reevaluation of onsite treatment processes for carbon tetrachloride. Battelle Seattle Research Center will continue with their assessment of ARARs for treatment alternatives, coordinating their efforts with Ebasco.

Planning - A planning proposal has been prepared to initiate an expedited response action (ERA) on dissolved CCl_4 contamination in the unconfined aquifer underlying the 200 West Area. The document (WHC-SD-EN-PD-012) has been released.

Evaluation of an in-well sparging techniques for the removal of VOCs from groundwater is being conducted as a collaborative effort between this ERA and the VOCs Arid ID. One of these techniques is being developed at Stanford University and is being considered for testing at the Hanford Site. (SJT)

Volatile Organic Compound-Arid Integrated Demonstration Operations -

The first FY 1993 milestone for Demonstration Operations was completed by delivery of the FY 1993 Site Characterization Work Plan for the VOC-Arid ID and 200 West Area Carbon Tetrachloride ERA (WHC-SD-EN-AP-109) to RL. This plan will guide FY 1993 characterization activities at the 200 West Area Carbon Tetrachloride Site. Activities will support conceptual model and baseline information requirements as well as provide for individual principal investigator needs. This characterization will be a combined effort other VOC-Arid ID and the 200 West Area Carbon Tetrachloride Expedited Response Action; it will combine resources to more efficiently meet the objectives of both programs.

The Integrated Test Plan for the Off-Gas Membrane Separation System demonstration has been approved. This system will condense and remove carbon tetrachloride form the VES off-gas. The demonstration will commence once the VES begins 24-hour operation.

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The Integrated Test Plan for directional boring at the Hanford Site is currently out for review. This demonstration will address the feasibility for the DITCH WITCH directional boring technology at the Hanford Site. (KJK)

Public Involvement - Filming of the VES site and field crew was conducted by a film crew from "Beyond 2000," an Australian television program which is seen in over 60 countries, including in the United States on the Discovery Channel.

A site visit was conducted between the ERA and Los Alamos personnel, several who are interested in both ERA and VOC-Arid ID activities, as they apply to environmental work at their site. Arrangements are in progress to include LANL in workshops on the ERA/VOCs Arid ID, to be conducted next spring. Separate workshops will be held for the Idaho Falls National Lab and Rocky Flats.

Zinfer Ismagilov, head of the Department of Environmental Catalysis at the Boreskov Institute of Catalysis spent a day with Environmental Restoration Engineering, ERA, and VOCs Arid ID Program staff discussing environmental restoration activities and associated technology development activities.

A presentation on the cone penetrometer demonstration was provided by Applied Research Associates (ARA). The demonstration included collaborative efforts around the carbon tetrachloride site. Future work between ARA and the ID/ERA work is planned.

Training - DOE-HQ has now approved funding for the conduct of a two-week training session for Russian nuclear environmental workers. One week of training will be spent at the Hanford Site (week of April 12, 1993). The training will utilize both WHC and PNL resources and is being led for DOE by a PNL/WHC team.

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GROUND PENETRATING RADAR INVESTIGATION FOR RIVERLAND ERA

K. A. Bergstrom and T. H. Mitchell
Westinghouse Hanford Company
Geoscience Group
Team Geophysics

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1.0 INTRODUCTION

The Riverland ERA includes four sites within the 100-IU-1 Operable Unit. Ground Penetrating Radar (GPR) was conducted at two of the four sites, Riverland Rail Wash Pit (RRWP) and the Anti-Aircraft Artillery (AAA) site number 70 (Figure 1).

The RRWP operated from 1943 through 1954 where radioactive decontamination was conducted on outgoing rail cars from the Hanford site in the locomotive house maintenance pits. In 1963 the RRWP facilities (Figure 2) were decontaminated, demolished, and the remains buried (Valcich 1992).

The AAA site was established in 1951 but remained active for only a few years (Valcich 1992). The site was demolished and all that remains are a few "outcrops" of foundations and three enigmatic mounds.

Five individual GPR investigations were conducted as part of the overall Riverland ERA package; two locations at the RRWP (Figure 3) and three locations at the AAA (Figure 4). Each investigation consisted of gridded survey designed specifically for each individual site.

GPR geophysical surveys at RRWP had two objectives; to locate the buried maintenance pits and to determine whether a 12,000 gallon underground diesel fuel storage tank was removed during decommissioning.

At the AAA site, GPR was conducted over the three "mounds" to determine what, if anything, was buried beneath them.

This report summarizes the interpretation of the GPR investigations for all five sites. The GPR data is contained in a data package, Bergstrom and Mitchell, 1992.

2.0 GEOLOGIC SETTING

The RRWP is situated on the south limb of the Waluke syncline which lies between two, topographically high, anticlinal ridges; Saddle Mountain and the Umtanum Ridge. The suprabasalt sediments that underlie the site includes the Ringold Formation, Hanford formation, and Holocene surficial deposits (Figure 5).

Regionally, the Ringold Formation varies from gravel dominated intervals to mud dominated intervals. The upper Ringold, which consists primarily of silts and sands, has most likely been removed during the Missoula floods. In its place is the Hanford formation, which in this area is dominated by high energy fluvial flood gravel deposits.

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The Holocene sediments are primarily Columbia River and eolian deposits. The river deposits consist of gravels and coarse-grained sands deposited in channels and overbank silts and fine sands. Eolian deposits consist of a thin veneer of fine silty sands overlying the coarse Columbia River gravels and/or Hanford formation gravels (Lindsey 1992).

The depth investigated with the GPR was limited to the Holocene and possibly the upper Hanford formation.

The AAA site is located on the south limb of the Umtanum Ridge structure. The supra-basalt sediments are thin in this area with depth to the top of the basalt being less than 25 feet. The Ringold Formation is not present and the Hanford formation, if present, is limited to slackwater Touchet bed silts and sands, and scattered gravels from iceberg remnants related to the Missoula floods. Eolian silty loam is believed to be the predominate material overlying the basalt. However a petrocalcic horizon consisting primarily of basalt colluvium immediately overlies the basalt and may be up to 10-15 feet thick.

3.0 GROUND PENETRATING RADAR METHODOLOGY

The Ground Penetrating Radar (GPR) system used for this work utilized a 300 Megahertz (MHz) antenna to transmit the electromagnetic (EM) energy into the ground. The transmitted energy is reflected back to a receiving antenna where variations in the return signal are recorded. Common reflectors include natural geologic conditions such as bedding, cementation, moisture, and clay, or man-made objects such as pipes, barrels, foundations, and buried wires.

Depth of penetration at Hanford is generally between one to fifteen feet, depending on the subsurface conditions, which can vary from site to site. The method is limited in depth by transmit power, receiver sensitivity, and attenuation of the transmitted energy. Depth of investigation is also influenced by highly conductive material, such as metal drums, which reflect all the energy back to the receiver. Therefore, the method cannot "see" below such objects.

Display and interpretation of the data is similar to seismic reflection data. In some areas interpretations can be straight forward, but often unknown parameters within a highly variable subsurface yields complex data.

Data for these surveys were collected with a Geophysical Survey Systems Inc. (GSSI) Subsurface Interface Radar (SIR) System

concluded that the survey was conducted over the location of the original RRWP building (Figure 3).

It is believed that the "H" shaped anomalous zone include portions of the original "pits" as shown in Figure 7. The "pits" appear to be partially filled with debris. Figures 8 and 9 show GPR data across the pits.

5.2 RRWP Diesel Tank

The objective of phase II was to determine if a 12,000 gallon diesel tank had been removed, and if not, where the tank was located. From facility plans and aerial photographs, it was determined that the tank, if present, should be located approximately 50 feet to the southwest of the locomotive house (Figure 3). An EM-31 Electromagnetic Induction (EMI) instrument was used for reconnaissance investigation. The area was full of metallic debris making it difficult to differentiate between individual anomalies. However, an area with a greater density of anomalies was found in the proximity of the tank location, based upon available facility maps and photos. The EMI surveys were conducted and interpreted real-time as a tool to refine the size and location of the grid that would be used for GPR. The EMI data were not recorded.

Based on the reconnaissance EMI survey and the facility plans, a 50 X 100 foot grid (Figure 3) was selected for the investigation. The data revealed a complex mixture of disturbed zones, buried debris, linears, geologic features, and numerous isolated anomalies.

A disturbed zone, between N70 to N90 and E10 to E40, is the only anomalous area identified, within the grid, that is large enough for a 12,000 gallon tank. There isn't a large "tank like" anomaly within this zone, rather the zone is filled with buried, scattered, conductive debris (Figure 10). According to facility drawings, the boiler house was at this location indicating that this possible tank location is unlikely (Figure 11).

A smaller disturbed zone, located 10-15 feet east of the large zone, displays a relatively strong, buried anomaly at E60/N74 (Figure 10). This anomaly does not appear to be large enough for a 12,000 gallon tank though.

Centered around E45/N100 is a shallow "slab-like" feature that appears to be a portion of one of the original buildings, specifically the coal storage building (Figure 11).

Three linears were identified that potentially represent utilities/pipes. Two are east-west trending features, at N95 and N100. The third is a north-south linear at E68. These linears

8, model 4800. The data was digitally stored on a GSSI DT6000A tape drive. A recording window of 100 nanoseconds, two-way travel time was used.

4.0 GRIDS

All five GPR investigations were gridded surveys. Distances were measured and posted in feet. Green stakes mark the corners of each grid. The southeast corner of the each grid is designated E100/N100 and serves as the "origin" for the survey locations. The number refers to a distance in feet. For example, grid point E135/N120 lies 35 feet "east" and 20 feet "north" of grid point E100/N100. The letters "N" or "E" refers to a direction that trends generally north or east, respectively. Two sets of orthogonal profiles were collected at each site with a five foot spacing between profiles.

5.0 RESULTS

5.1 RRWP "Pits"

The RRWP investigation was conducted in two phases. The second phase is discussed in section 5.2. The objective of phase I was to locate the buried maintenance pits located within the locomotive house (Figure 3). Aerial photographs (before and after demolition) were used for approximating the location of the locomotive house. A 60 X 120 foot grid (Figure 3) was established over the assumed location. Several GPR profiles were extended beyond the grid to enhance the interpretation on a "real time" basis.

A summary of the interpretation of the GPR data is shown in Figure 6. The data revealed several strong near surface reflectors that are similar in character to concrete slabs. In the northwest corner of the grid a shallow "slab like" reflector has a consistent signature while the "slab like" reflectors throughout other portions of the grid display more discontinuity. Two parallel disturbed areas, with similar reflective characteristics, pass through the middle of the grid. They correlate with a pair of railroad tracks that went through the locomotive house (Figure 2). The rails may have been removed leaving the foundation for the tracks. In the western half of the grid there is an "H" shaped disturbed zone, 2-5 feet below the surface. Portions of the "H" zone contain some "slab" like reflectors.

The interpretation of the GPR data was compared to the construction plans for the facility; there were no "as built" drawings available. The comparison yielded definite similarities; enough to

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but all of these anomalies appear to be relatively isolated and insignificant.

The relationship of an exposed vertical pipe (Valcich 1992), located in the southwest corner of the grid, to a possible subsurface feature wasn't apparent in the data. An extension of the grid to the west and south would be required to more thoroughly investigate the feature. This area is heavily vegetated with sage brush requiring removal before additional data could be acquired.

5.3.2 AAA #2

The primary features identified in AAA #2 were an anomalous zone between N108 and N155 and a shallow east-west trending linear between N100 and N110 (Figure 15). The zone includes a shallow, pervasive, near surface reflector (less than 2 feet deep), which overlies a second reflective horizon 1-2 feet beneath it (Figure 16). The shallower reflective horizon appears to be another "slab-like" anomaly. The lower reflector is more puzzling. It is less pervasive which could be a function of depth or partial masking by the upper reflector. It is not detected outside of the extent of the upper horizon. Both seem to be the remnants of a building or structure.

There are several small scattered anomalies within the mound. They appear to be debris left from the demolition of the original structures.

The linear anomaly has the characteristics of a utility line or buried pipe. A possible scenario is that the linear represents a utility line that led to a building that was located in the anomalous area described above.

5.3.3 AAA #3

The primary features in AAA #3 are two anomalous zones and a north-south trending linear between E120 and E130 (Figure 17). The northern most anomalous zone has the characteristics of a shallow (1-2 feet below the surface) concrete slab. The southern anomalous zone is characterized as more "disturbed" relative to the surrounding area. Some debris appears to be buried within the mound. The linear anomaly is approximately two feet below the surface. It could be a section of pipe, cable, or the remnants of a foundation wall.

6.0 SUMMARY

The comparison of the interpretation of the GPR data and the facility drawings for the RRPW site yielded enough similarities to

probably correlate with the east-west and north-south trending pipes in the drawing even though their locations don't perfectly match. A fourth, southwest-northeast trending linear, located in the northeast corner of the grid is more puzzling since there are no pipes or utilities in the plans that have a similar orientation (Figure 10). However, this linear lies in the most direct path from the locomotive house to a potential fuel tank location.

A small anomaly at E85/N60 appears to correlate with a manhole related to a sewer line shown on the facility drawings (Figure 11). The pipes into the manhole were not detected suggesting that they may be tile pipes.

Based on correlation's between the GPR data, aerial photographs, and facility drawings, it appears that the grid was adequately located. However, there are no anomalies that appear to be from a 12,000 gallon tank. Figure 12 shows a GPR profile across the survey area depicting many of the anomalies discussed here.

It is possible that the tank is located beyond the survey boundaries. But it seems unlikely since the GPR data, facility drawings, and photos indicate that locations of buildings are relatively accurate.

Even though the facility drawing for the diesel tank and it's feeder lines do not correlate exactly with the GPR data, the general "pattern" of linears, disturbed areas, and possible concrete slabs resemble those of the aerial photographs and facility drawings.

5.3 Anti-aircraft (AAA) Sites

The objective of the AAA investigations was to determine if "debris" was buried beneath three enigmatic mounds. There was concern that the mounds might include buried hazardous material. No site plans, air photographs, or facility plans were available for the AAA site.

A grid was constructed over each mound, the size dictated by the size of the mound being investigated. Adjacent heavy vegetation limited the size of the investigation in some cases.

5.3.1 AAA #1

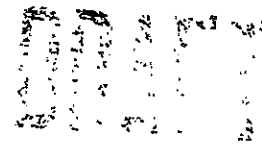
Gun site AAA #1 appears to be the remains of a foundation for a building. A strong shallow reflector (Figure 13), 1-2 feet below the surface, dominates the data. It has the characteristics of a buried cement slab. Exposures of concrete appear to be the remains from the foundation walls of a structure. These exposures and the shallow reflector are assumed to be directly related. Minor amounts of "debris" were detected outside of the apparent slab (Figure 14),

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FIGURES

- 1 Location map
- 2 Site plans RRWP
- 3 RRWP grid over area layout
- 4 AAA grid layout
- 5 stratigraphy
- 6 RRWP interpretation
- 7 RRWP interpretation + building
- 8 GPR example RRWP#1
- 9 GPR example RRWP#2
- 10 Tank interpretation
- 11 Interp + plans
- 12 GPR tank example
- 13 AAA #1 interp
- 14 AAA #1 example
- 15 AAA #2 interp
- 16 AAA #2 example
- 17 AAA #3 interp
- 18 AAA #3 example



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concluded that portions of the original "bits" were identified as shown in Figure 7. The "bits" appear to be partly filled with debris.

Based on comparison of the GPR interpretation, facility drawings, and air photos, it was concluded that the survey was conducted over the apparent location of the diesel tank. No anomalies of the size and character of a 12,000 gallon diesel tank were detected indicating that it may have been removed.

All three mounds at the AAA site appear to represent areas that once had buildings or structures related to the operations of the Anti-aircraft installation. Scattered, isolated anomalies in each of the sites are likely remnants of a building that once occupied each site. Air photos or drawings for the AAA sites would significantly enhance and help in confirming the interpretations.

7.0 REFERENCES

Bergstrom, K.A. and Mitchell, T.H., 1992, Data Package for Geophysical Investigations of Riverland ERA, WHC-SD-EN-DP-061.

Liikala, T. L., R. L. Aaberg, N. J. Aimo, D. J. Bates, T. J. Gilmore, E. J. Jensen, G. V. Last, P. L. Oberlander, K. B. Olsen, K. R. Oster, L. R. Roome, J. C. Simpson, S. S. Teel, and E. J. Westergard, 1988, Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins, PNL-5728, Pacific Northwest Laboratory, Richland, Washington.

Lindsey, K. A., 1992, Geology of the Northern Part of the Hanford Site: An Outline of Data Sources and the Geologic Setting of the 100 Areas, Westinghouse Hanford Company Report, WHC-SD-EN-TI-011, Rev. 0.

Valcich P. J., 1992. Riverland Expedited Response Action Project Plan. Westinghouse Hanford Company Report, WHC-SD-EN-AP-102.

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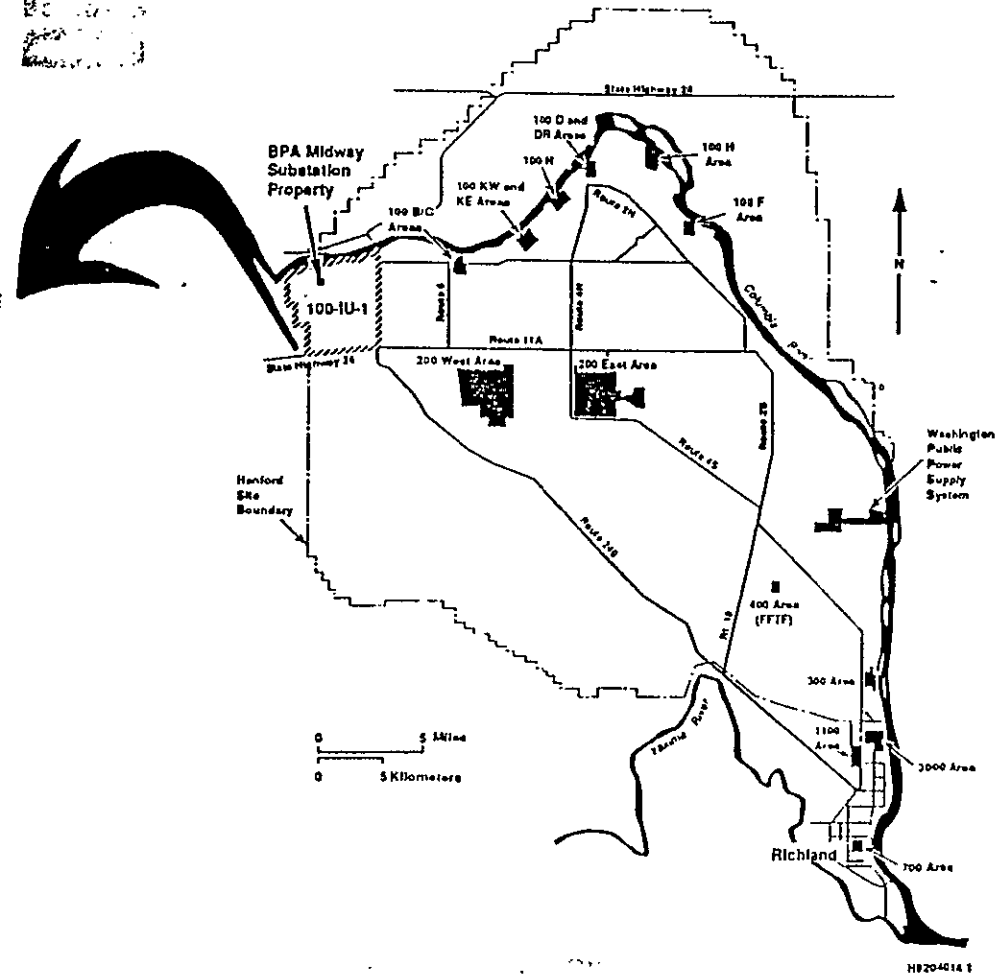
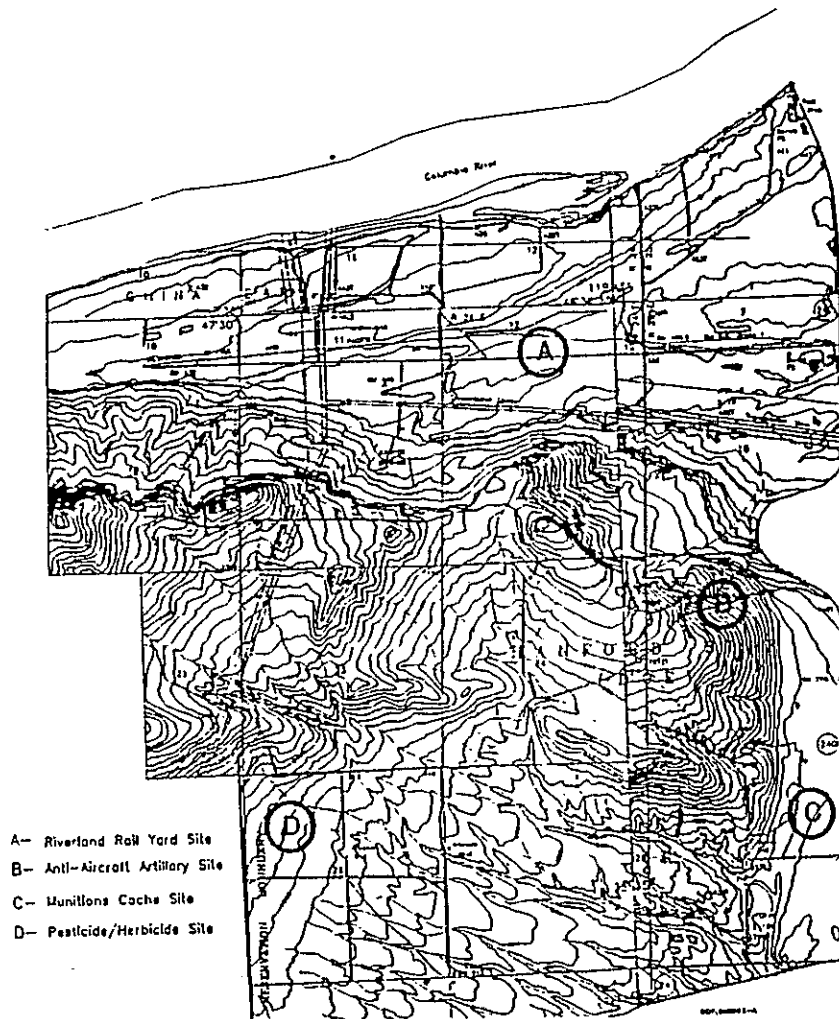
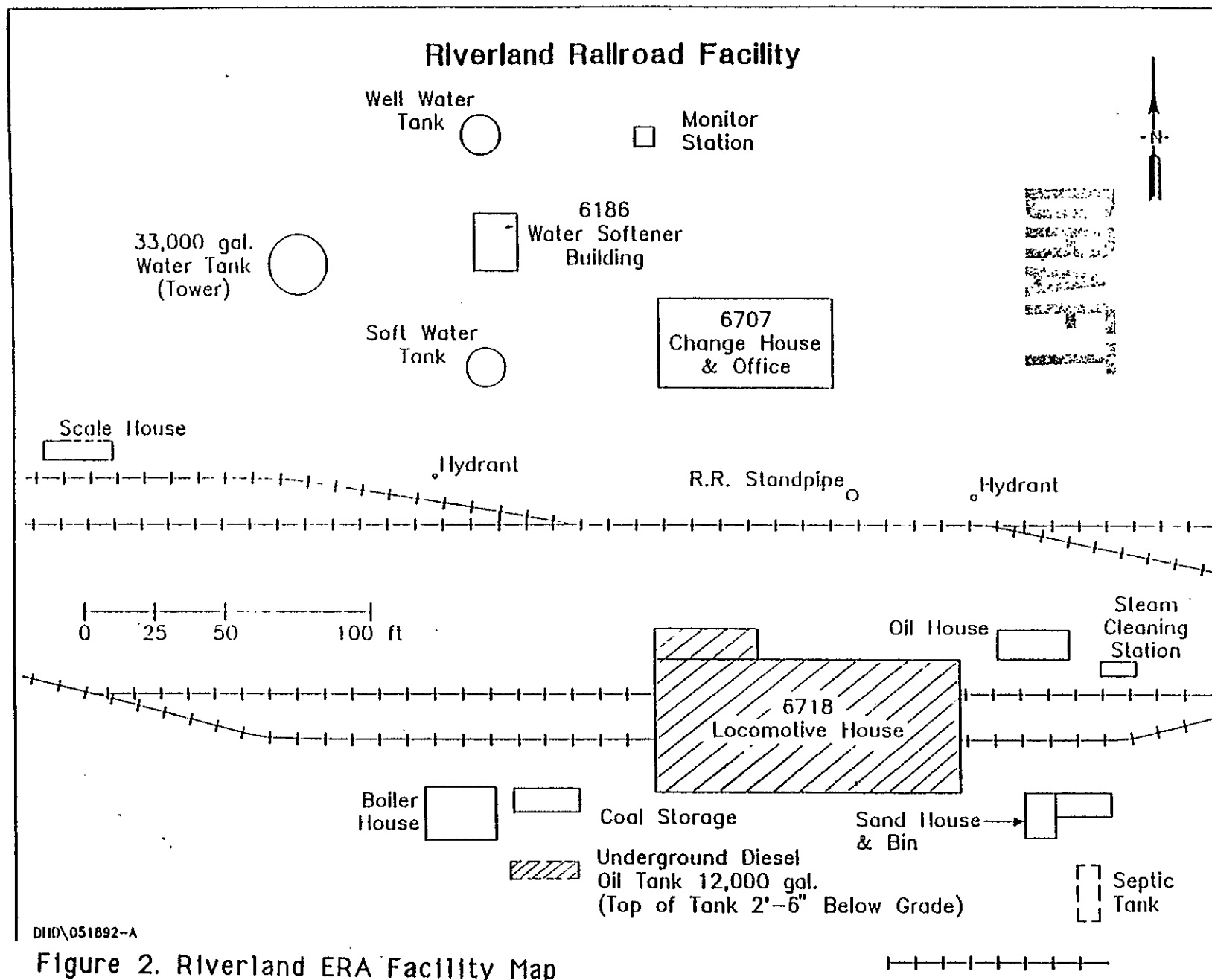


Figure 1. Location Map for Riverside ERA

A- Riverland ERA Railroad Site
B- Anti-Aircraft Artillery Site

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Figure 2. Riverland ERA Facility Map

Locomotive House and Diesel Oil Tank primary targets.

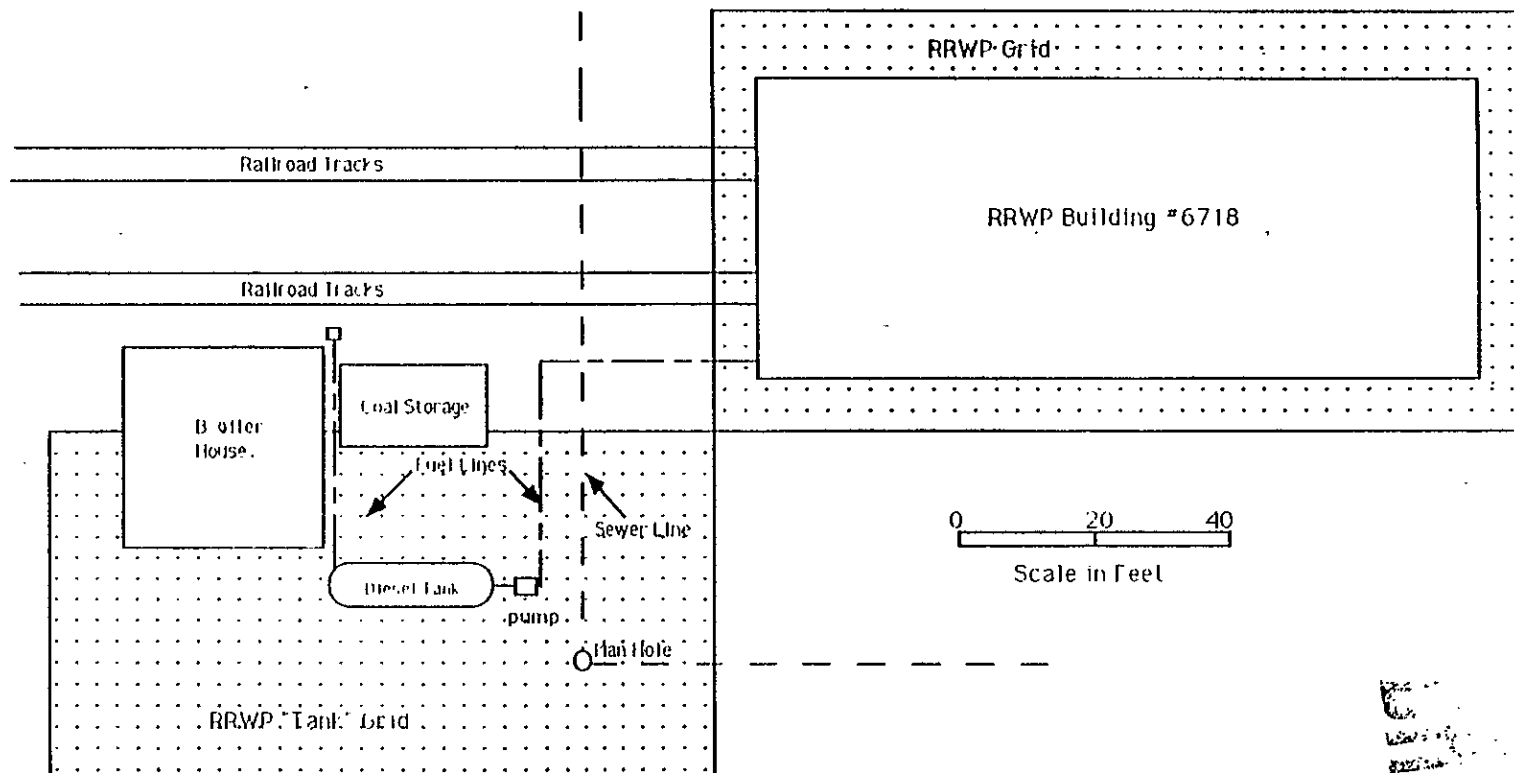


Figure 3 Diesel Fuel Tank and Surrounding Facilities.
From a Compilation of Drawings and Aerial Photographs.

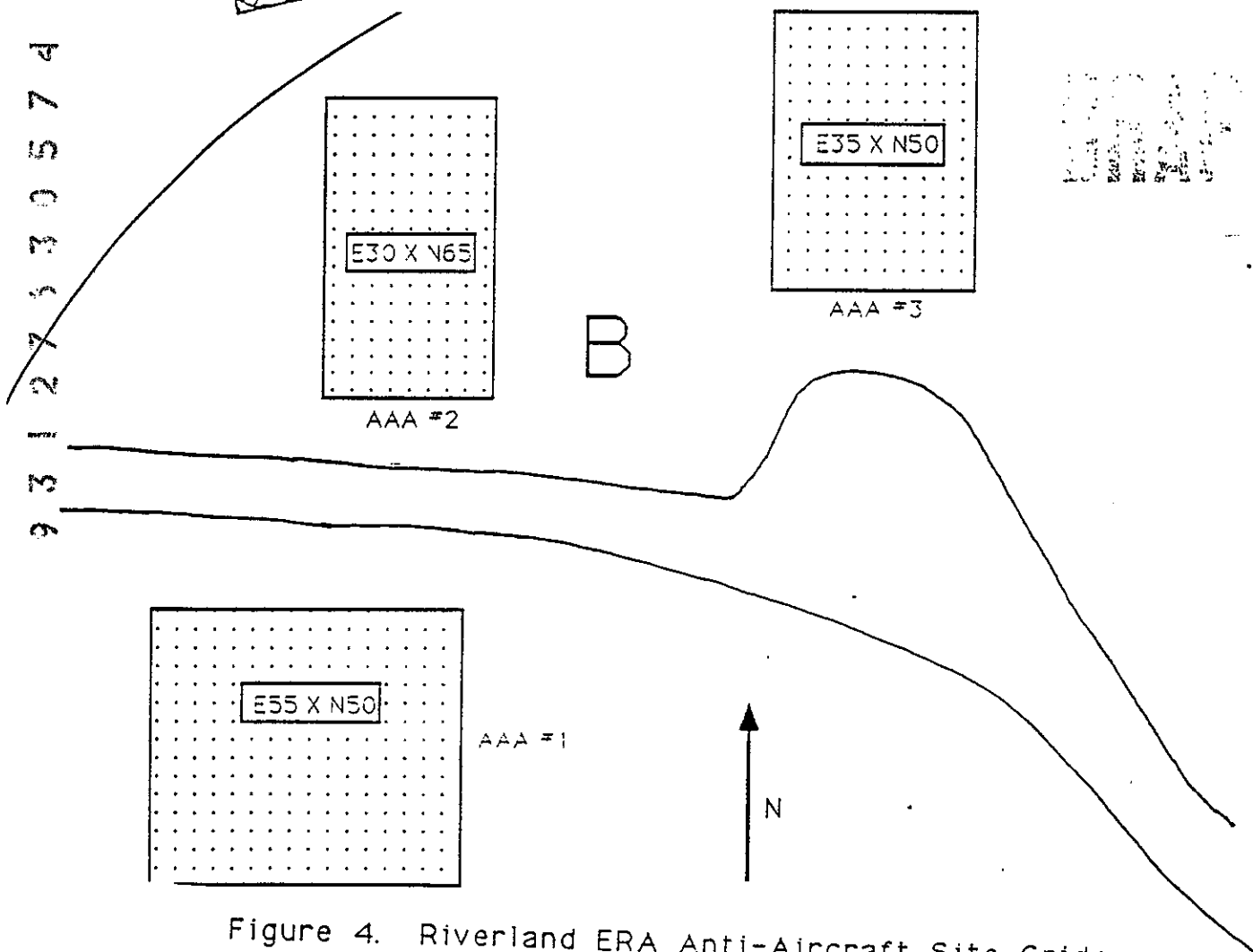
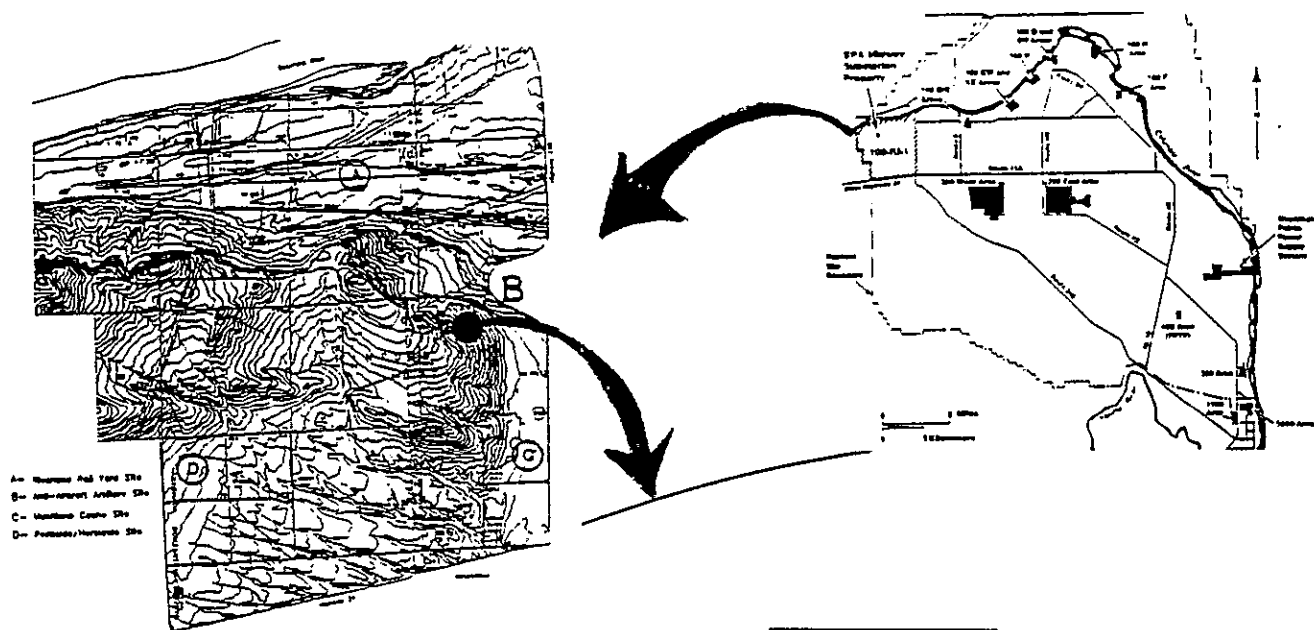


Figure 4. Riverland ERA Anti-Aircraft Site Grids.

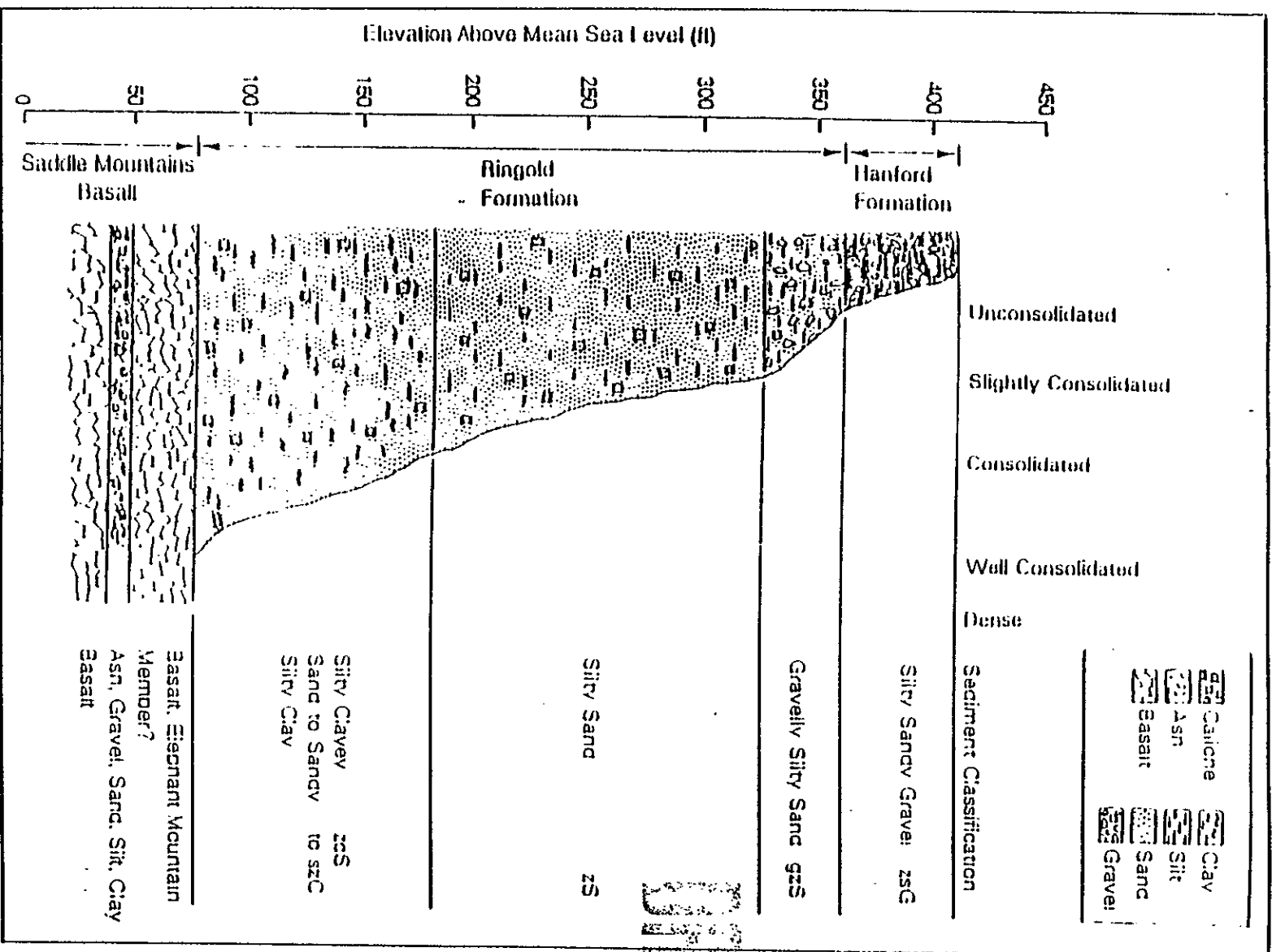


Figure 5. Generalized Upper Geostratigraphic Column for the 100-- Area after Wicks et al. (1988).

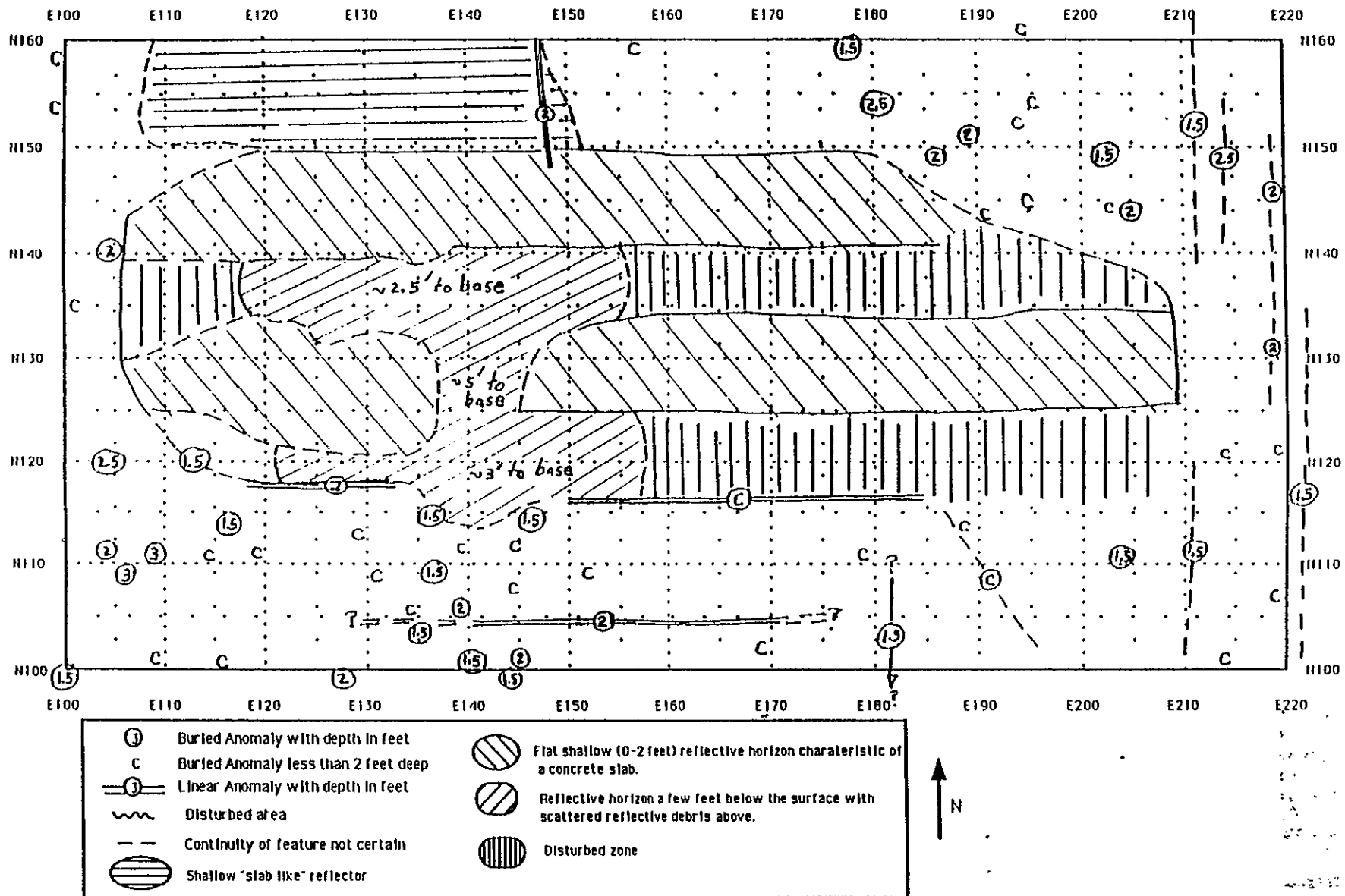


Figure 6. Ground Penetrating Radar summary Interpretation of the Riverland ERA railroad depot.

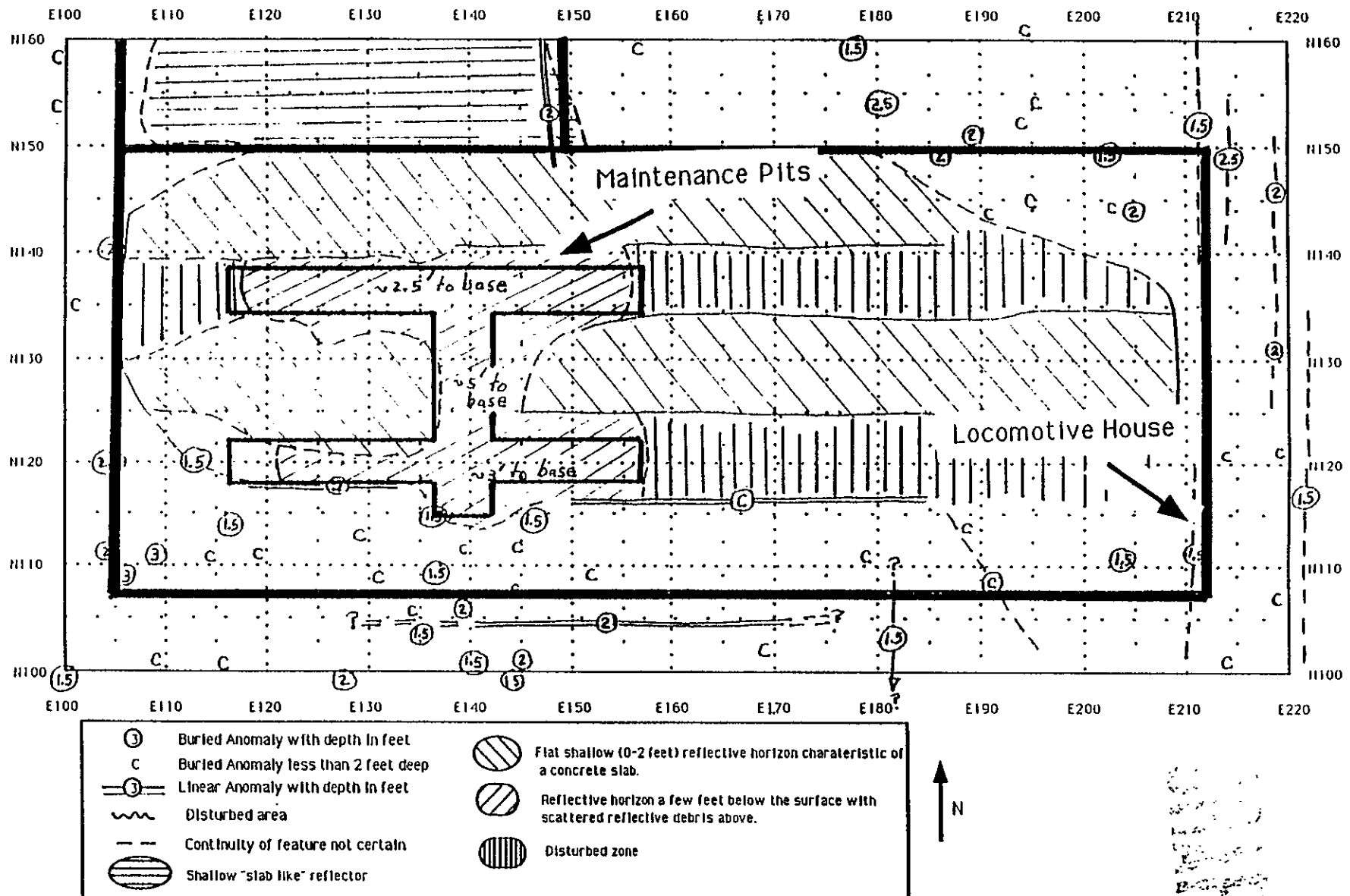
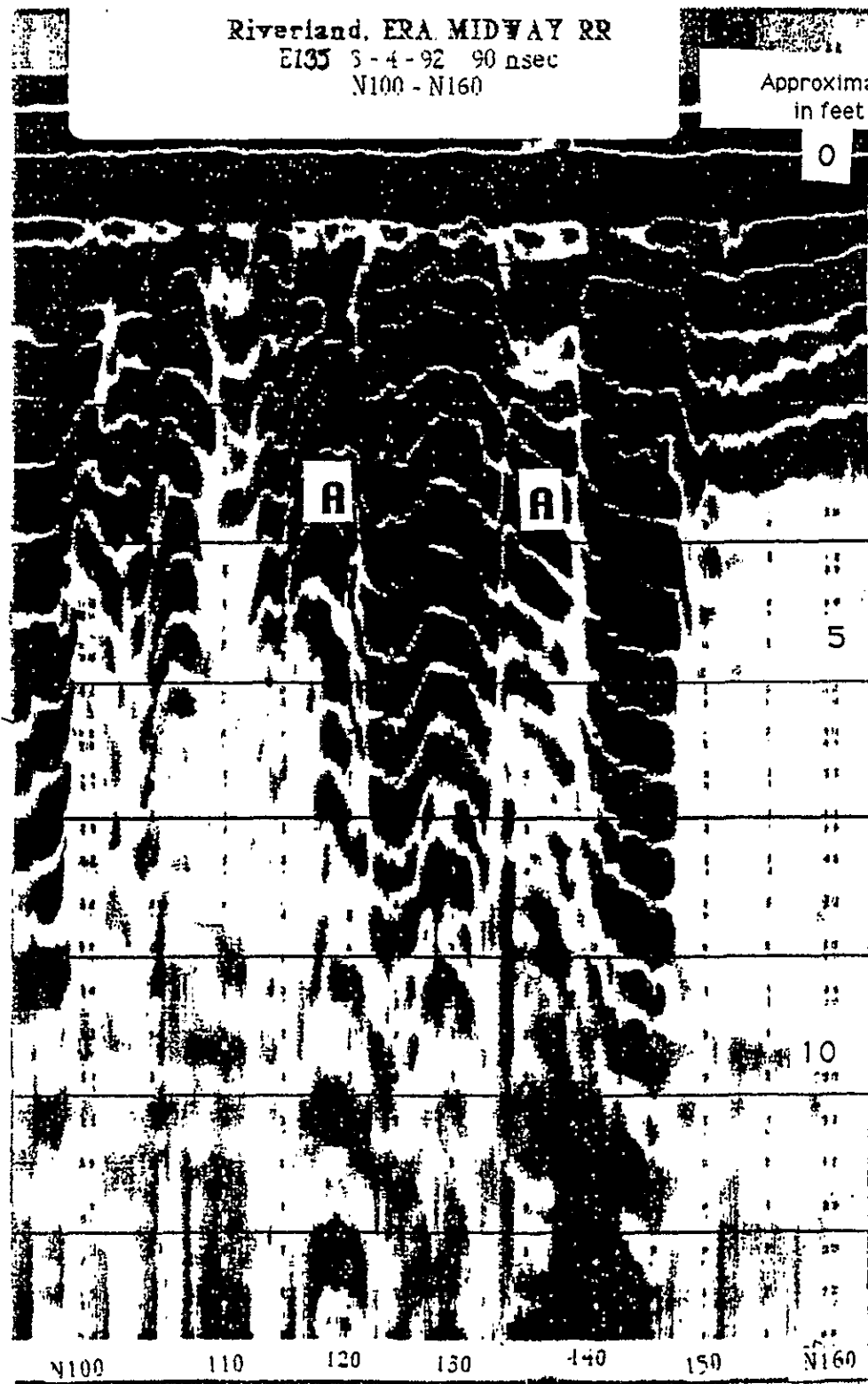


Figure 7. Interpretation Summary of RRWP with Facility Overlay.

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Figure 8. Interpreted "Pits" Surrounded by "Slab-Like" Anomalous Features; Profile E135.

Riverland, ERA, MIDWAY PR
 N135 S-4-92 90 nsec
 ES5 - E220

Approximate Depth
 in feet

0

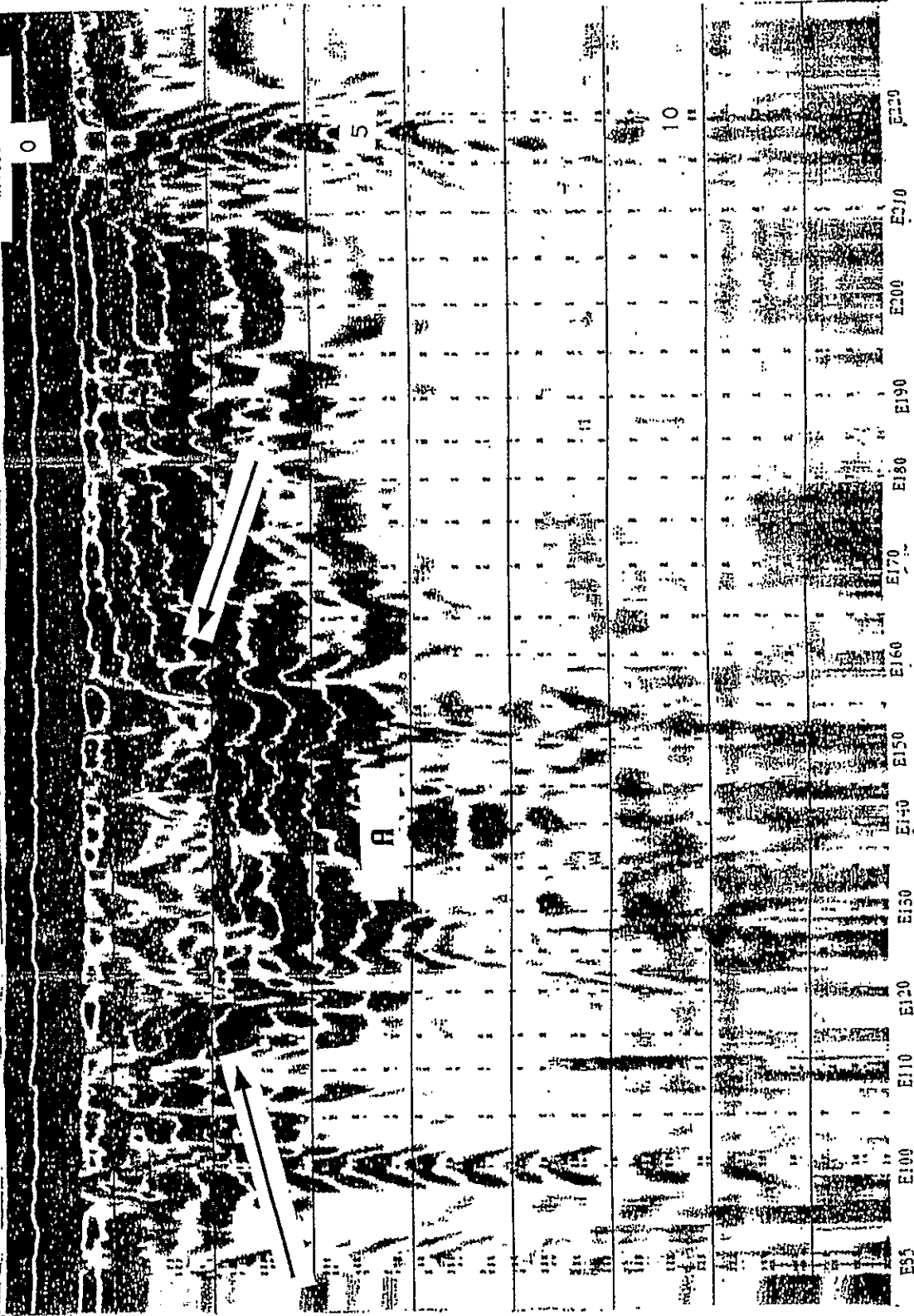


Figure 9. Interpreted Long Axis of "Pit"; Profile N135.

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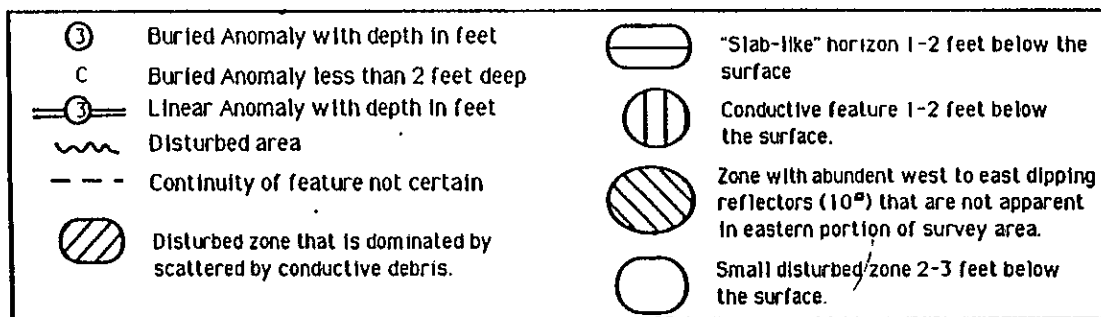
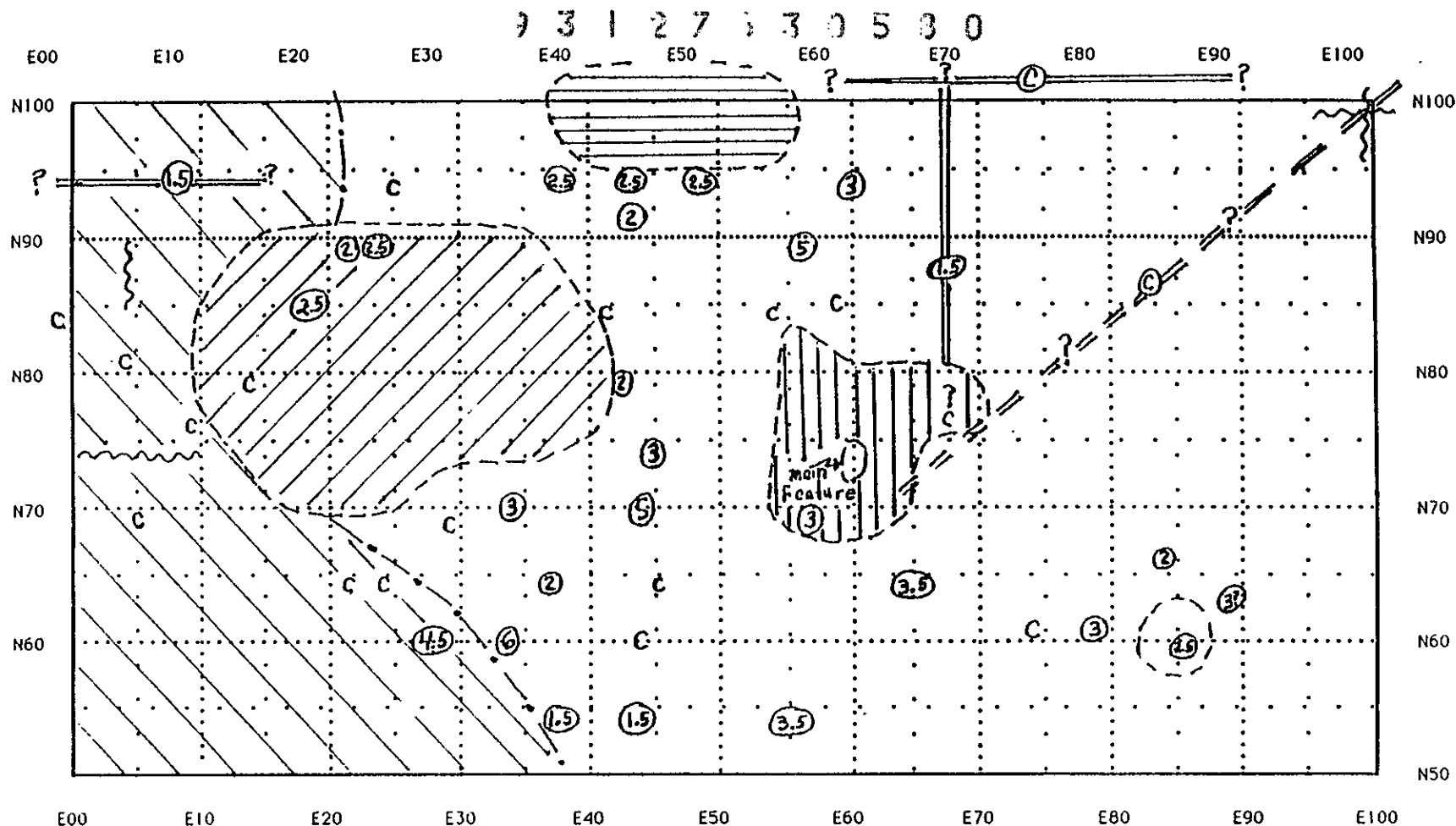
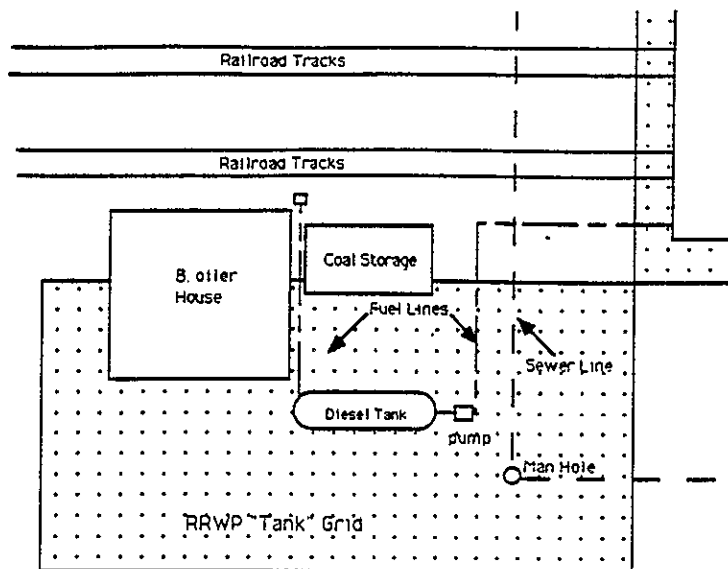


Figure 10. GPR Summary Interpretation Map of the Riverland ERA Diesel Tank Investigation.



201

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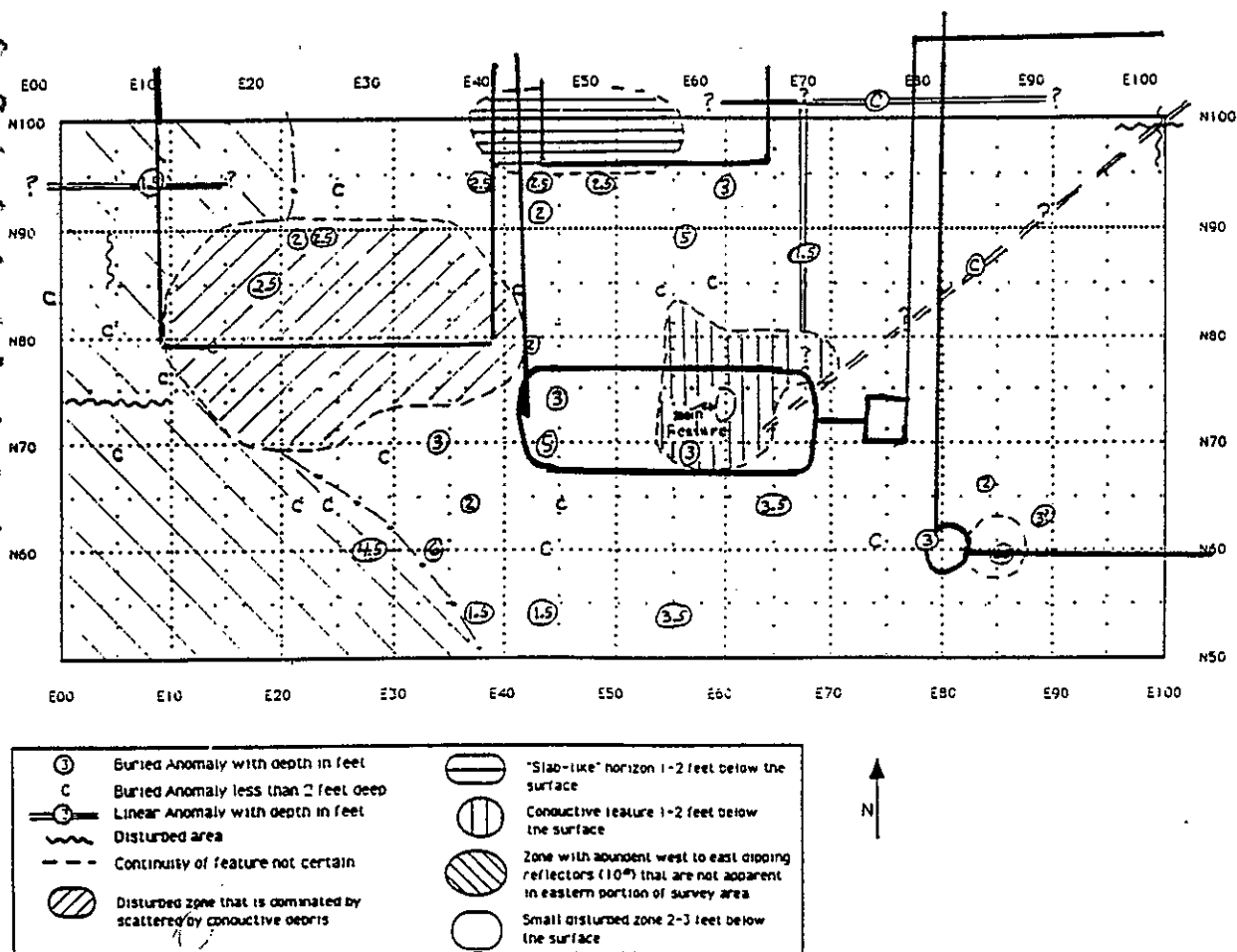


Figure 11. Summary Interpretation of Diesel Tank Investigation Overlaid by Apparent Facility Locations.

2 3 1 2 7 5 3 7 5 9 2

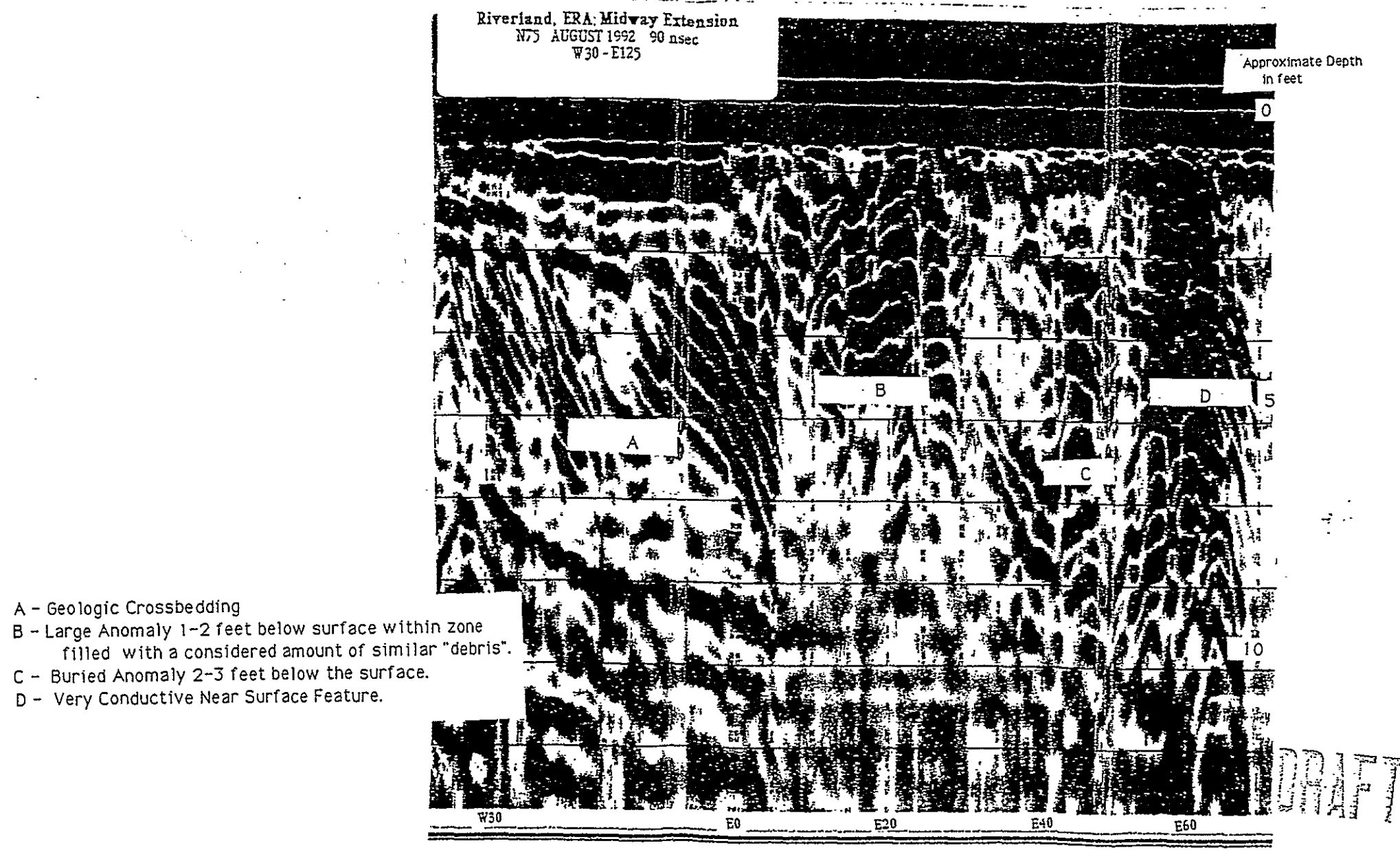


Figure 12. Interpretation of GPR Profile N75, Diesel Tank

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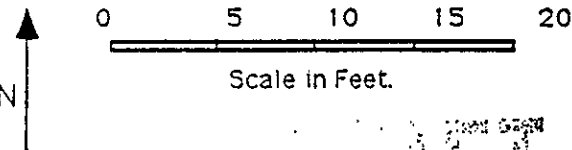
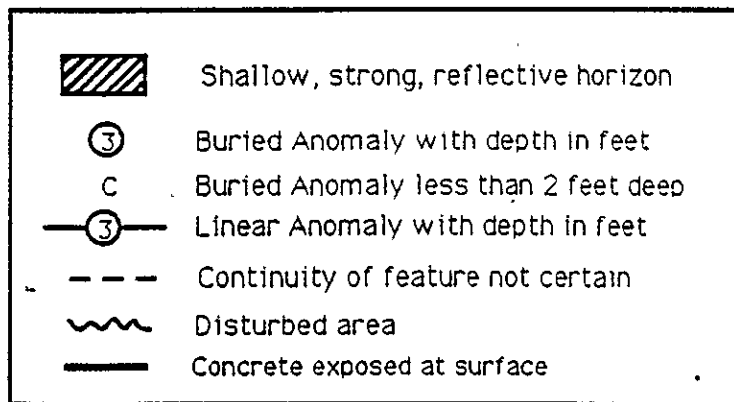
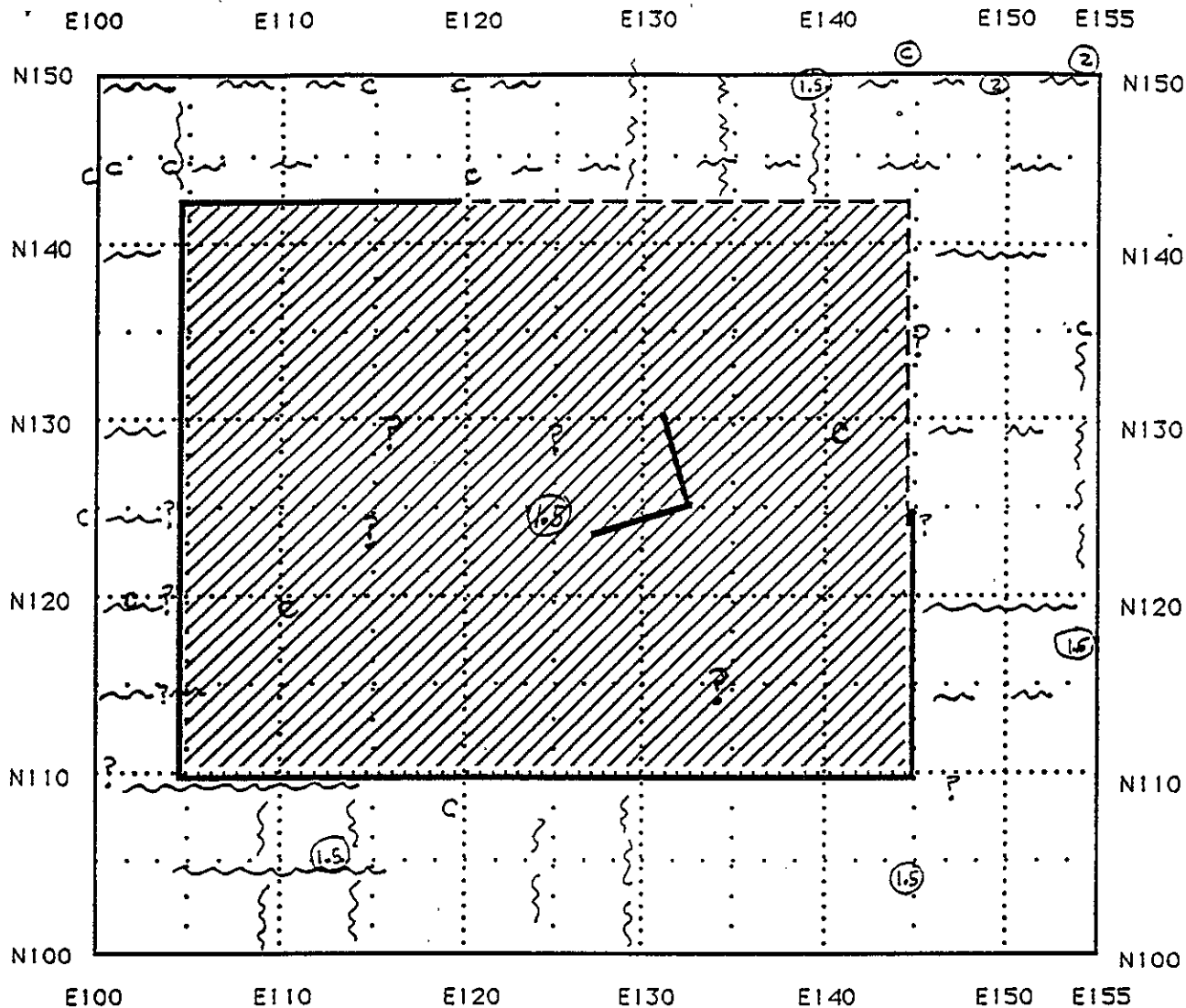


Figure 13. GPR Interpretation Summary of Riverland ERA Anti-Aircraft Site #1.

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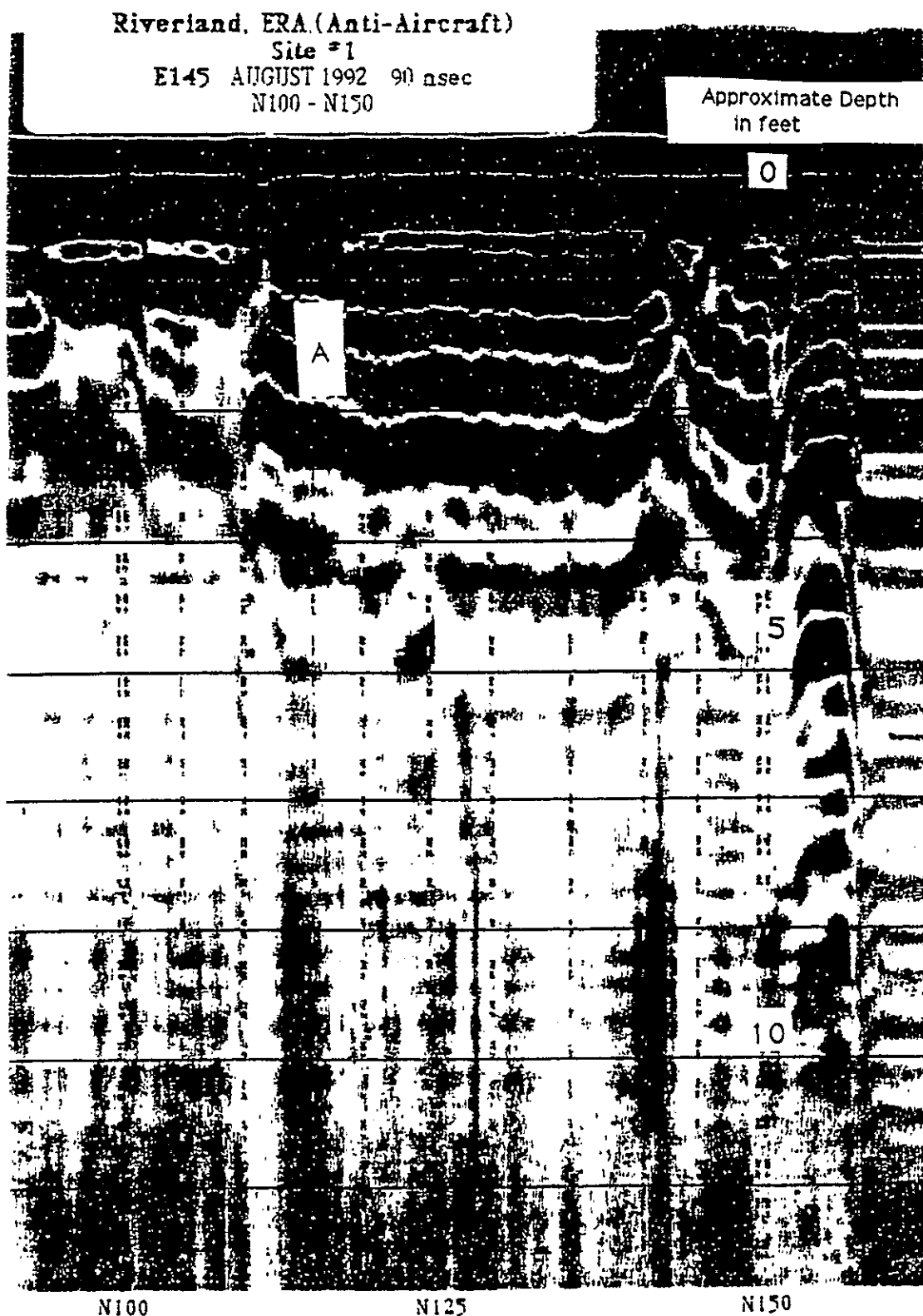
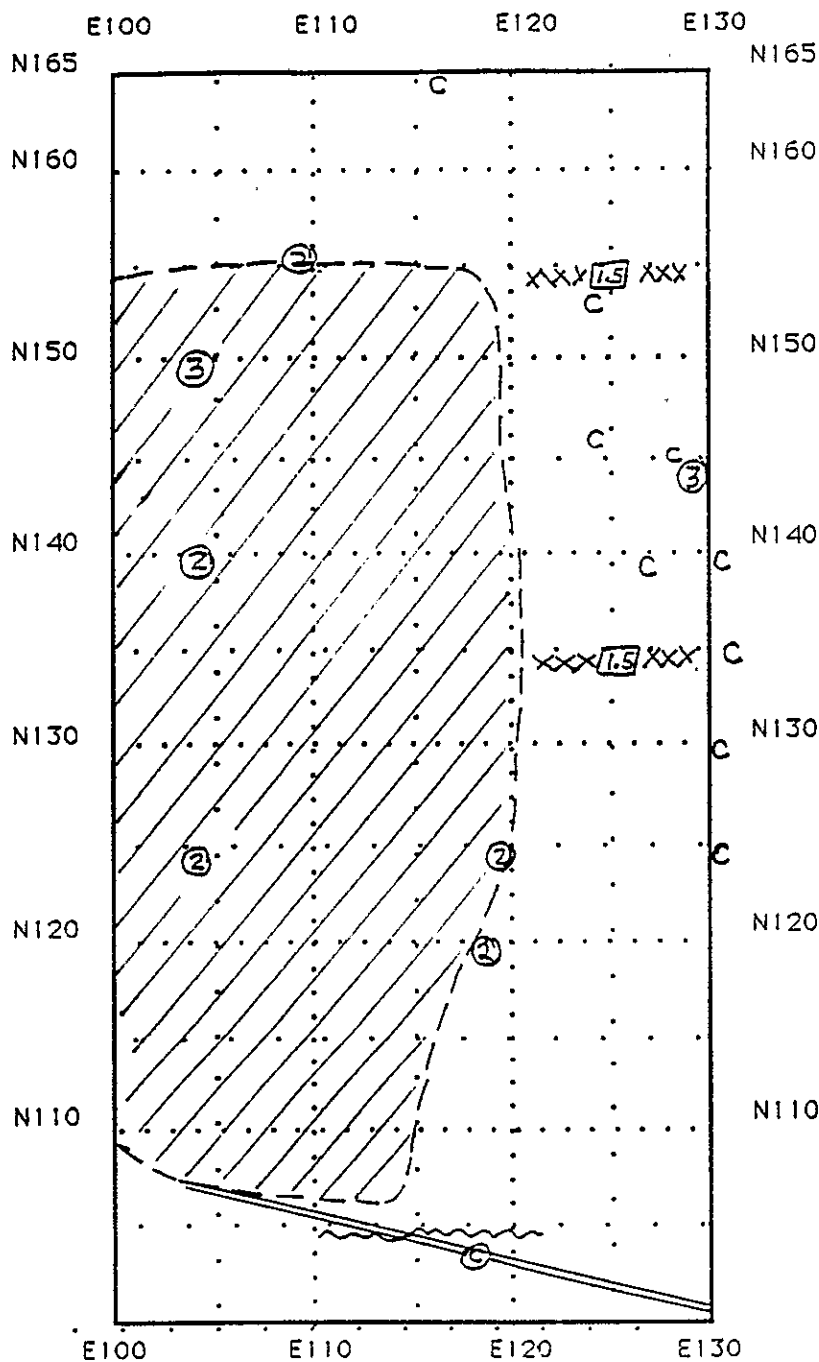


Figure 14. GPR Profile E145, AAA Site #1.

A - Shallow "Slab-Like" Feature

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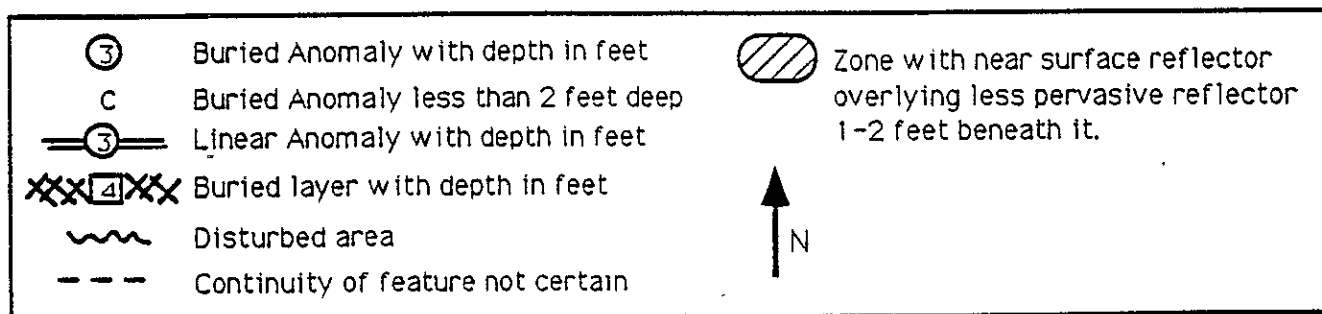


Figure 15. GPR Interpretation Summary of Riverland ERA Anti-Aircraft Site #2.

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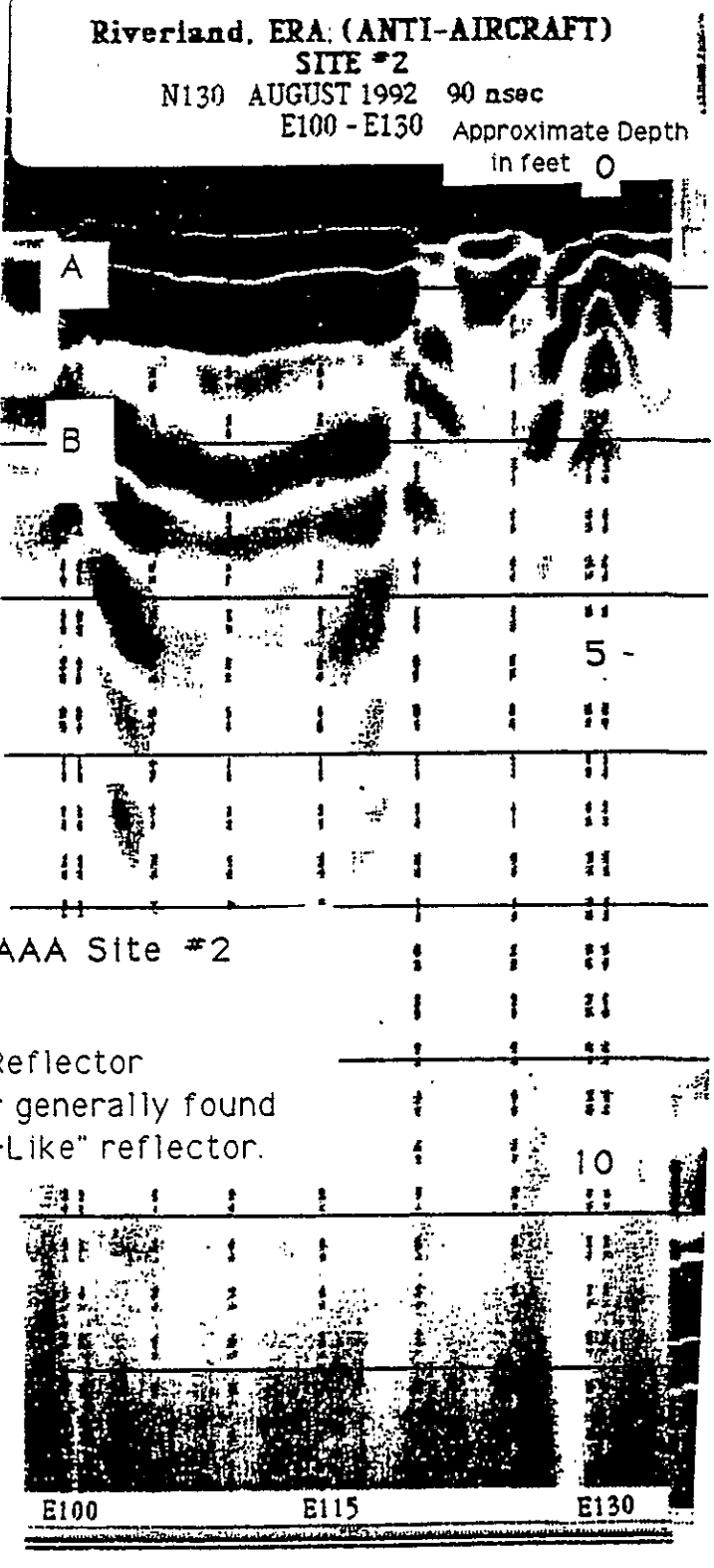
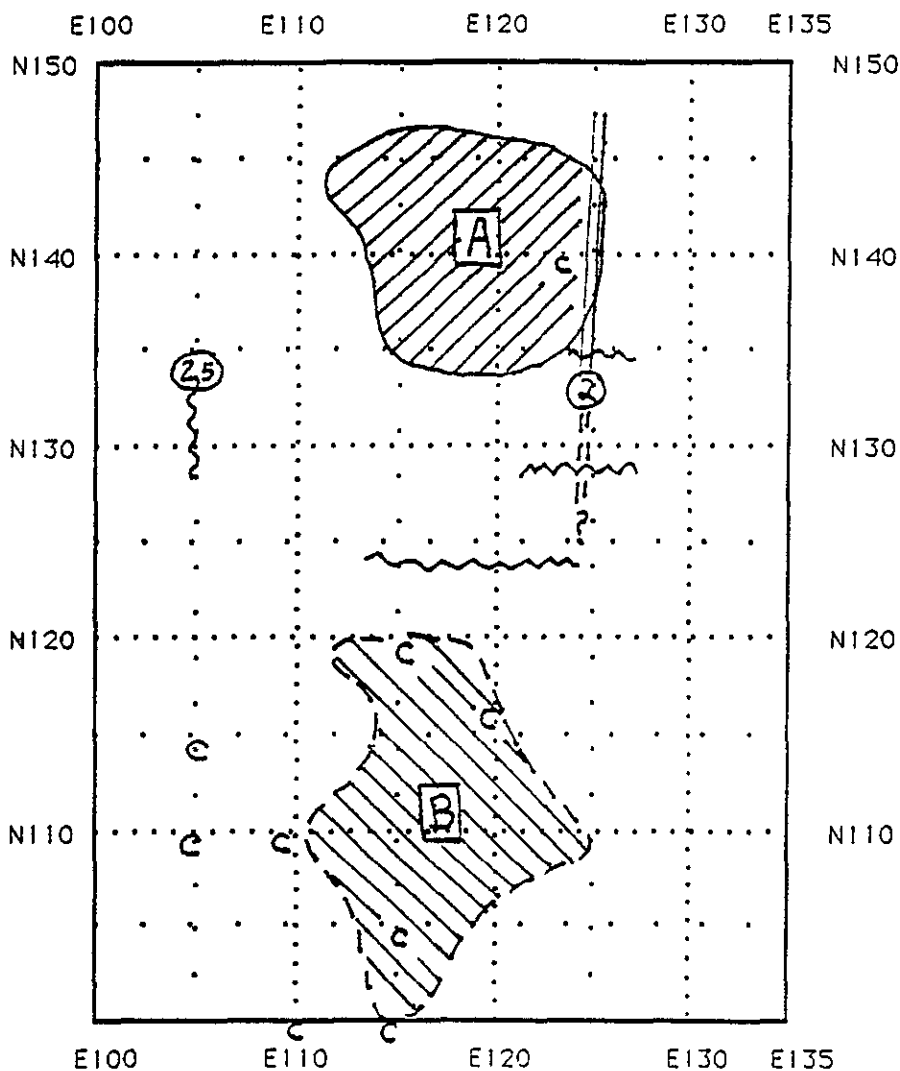


Figure 16. GPR Profile N130, AAA Site #2

- A - Shallow "Slab-Like" Reflector
- B - Intermittent Reflector generally found
1-3 feet below "Slab-Like" reflector.

Riverland ERA AAA #3 August 1992



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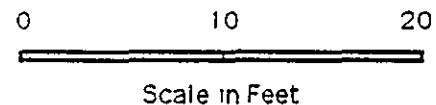
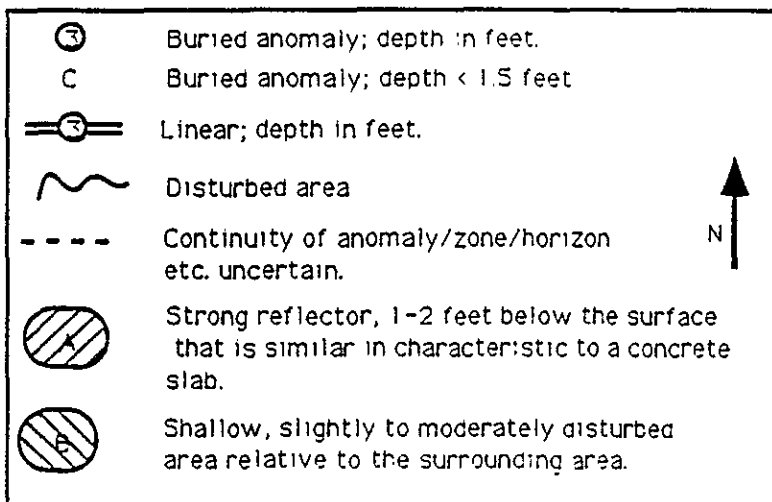


Figure 17. GPR Interpretation Summary of Riverland ERA Anti-Aircraft Site #3.

Riverland, ERA (Anti-Aircraft)
 Site #3
 E115 AUGUST 1992 90 nsec
 N100 - N150

Approximate Depth
 in feet

0

5

10

N100

N125

N150

Figure 18. GPR Profile E115, AAA Site #3

A - Disturbed zone containing "buried debris" 1-3 feet
 below the surface.

B - "Slab-Like" reflector 1-2 feet below the surface.

Field Screening for Heavy Metals with Portable XRF Units

R. G. McCain
S. J. Guzek

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- I. Title: Field Screening for Heavy Metals with Portable XRF Units
- II. Author's Name: Mr. R. G. McCain, MSIN H4-55
Westinghouse Hanford Company
P. O. Box 1970
Richland, WA 99352
- III. Co-Author's Name(s): S. J. Guzek
Westinghouse Hanford Company
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for R. G. McCain

Date: 4/27/92

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FIELD SCREENING FOR HEAVY METALS WITH PORTABLE XRF UNITS

R.G. McCain & S.J. Guzek
Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352
(509) 376-0777

ABSTRACT

Portable X-Ray Fluorescence (XRF) units are available for sample analysis or in situ measurement of heavy metals. In many field screening applications, it is sufficient to identify samples or areas in which contamination is present. This paper presents a new approach that provides a qualitative indication of heavy metal content with minimal sample preparation and data evaluation. In the "scan" approach, a portable XRF unit is configured to report the integrated gross count rate for each of several contiguous energy bands. Detection of heavy metal contaminants is based on comparison of gross count rates in each energy band with corresponding background levels from material with a similar matrix.

INTRODUCTION

In many field screening applications, a primary question is the nature and extent of contamination. Although accuracy and sensitivity are important, the time required to obtain results can be an overriding concern. Decisions relating to sample collection and disposition, interim designation of waste materials, or worker health and safety must often be made in a very short time without recourse to laboratory analytical results.

The overall quality of the sampling and analysis program can be greatly enhanced if samples collected for laboratory analysis are obtained with some knowledge of the range and spatial distribution of contaminant levels. Proper management of waste materials is facilitated when data regarding waste constituents are provided promptly. Worker health and safety are improved when contaminants present at a site are identified quickly allowing modification of the worker protection or site monitoring requirements where appropriate. During remediation or removal of contamination, the quantity of material to be treated and/or disposed can be greatly reduced if the presence of contamination can be determined on a real-time basis.

In these cases, it can be sufficient to identify samples or areas in which contamination is present. In this context, contamination can be defined as concentrations significantly above background levels. Also, it is not always necessary to provide specific identification of the contaminant involved.

Elements such as lead, arsenic, cadmium, chromium, zinc, mercury, and copper are frequently cited as contaminants of concern in soils at hazardous waste sites. These elements can be detected using XRF methods. In contrast to other instrumental methods of heavy metal analysis such as inductively coupled plasma spectroscopy (ICP) or atomic absorption (AA), XRF methods offer greater potential for field application. In particular, energy dispersive (ED) XRF systems offer the capability to detect and quantify a wide range of elemental contaminants with minimal sample preparation. In recent years, small portable ED-XRF units have become commercially available. These instruments generally consist of a probe unit with one or more gamma-emitting radioisotope sources and a detector, connected to a battery-powered electronics package which contains a high voltage power supply for the detector, multichannel analyzer, and associated electronics and microprocessors. Portable ED-XRF units are necessarily limited in their capability to excite and resolve characteristic XRF energy lines, but they offer the capability for quick field measurements. These instruments can also be used to make in situ measurements on soil, concrete, asphalt, or other surfaces.

FIELD SCREENING WITH PORTABLE ED-XRF UNITS

The use of portable ED-XRF units for field screening is not new. These instruments have been used to make field measurements in metallurgy, mining, and other fields. The Environmental Protection Agency (EPA) has identified portable XRF as a field screening technique and discussed its use to screen for lead contamination at a hypothetical superfund site in the guidance documents related to development and implementation of Data Quality

Objectives (DQOs)¹. Numerous papers describing the use of portable ED-XRF units in field screening of heavy metal contamination have been presented. The principles of XRF as applied to waste analysis are discussed by Kendall². A summary of the concept of field screening with portable XRF units is provided by Raab et al.³

Portable ED-XRF units are generally designed to provide a numeric output for several elements of interest. The instrument used to generate the data in this paper is the X-Met 880^{*}, manufactured by Outokumpu Electronics, Inc. The X-Met 880 is designed to operate in either an identify 'ID' mode or an assay 'ASSAY' mode. Each measurement mode is stored as a user-defined model in the instrument memory. The X-Met can maintain up to 32 models in memory. In the ID mode, the instrument compares data from unknowns with those from standards and identifies the best match, if any. This mode is designed primarily for alloy identification, and will not be discussed further. In the ASSAY mode, the X-Met 880 measures count rates for up to ten elements, applies peak overlap corrections, and provides up to six numeric outputs which are defined in terms of the corrected measurement values. Available outputs include the gross count rates, net (deconvoluted) count rates, assay values, and standard deviation (counting error) of the assay values. The ASSAY models are developed by first specifying the parameters to be measured. The instrument requests a measurement of the appropriate pure element spectra or recalls it from memory--these spectra are used to compute measurement ranges and peak overlap factors. The user then specifies the dependent outputs and measures a suite of calibration samples that contain a range of the elements of interest in a matrix similar to that in which measurements are to be made. During model development, the user specifies relationships between dependent (assay) outputs and the independent (net count rate) values. The X-Met computes the regression for each postulated relationship and stores the result. By evaluation of the regression statistics, the best relationship is selected and stored in the model parameters. This process is repeated for each of the six assay values. Ideally, this empirical calibration approach accounts for major interelement and matrix effects. However, the empirical calibration process requires a suite of calibration samples with similar matrix characteristics that have been spiked with a range of concentrations of each element of interest. If six assay values are to be determined, as many as twenty to thirty calibration samples could be required. In many field screening applications, however, such a suite of calibration samples might not be

available, or the contaminants of concern could be poorly defined. It is not always possible to use samples from previous projects as calibration samples, because matrix conditions can be different and the required analytes might not be present at appropriate concentration levels.

To take a measurement in the field, the operator selects the appropriate model from the X-Met front panel or computer interface, places the probe against the sample or surface to be measured and pulls the trigger. After the counting time is completed, the X-Met displays the six assay values on the front panel display. At this point, the net count rates and gross count rates can also be displayed by issuing simple commands from the X-Met front panel or computer interface, and the spectra may be downloaded for viewing and/or plotting. However, examination of these parameters or viewing of the spectra will require a portable computer. While such computers are available, their use in the field greatly restricts the mobility of the X-Met, and increases overall measurement and data evaluation time. What is needed is a means to make a determination regarding the presence of heavy metal contamination based on evaluation of the six assay values available from the X-Met front panel display. This has led to the development of "scan" models.

THE SCAN MODEL

The "scan" model concept is based on the observation that materials with similar matrix characteristics and element concentrations should exhibit similar XRF spectra under similar measurement conditions, assuming source energy and intensity remain the same. The integrated "background" count values for a given channel range should be similar for all uncontaminated sands, and a contaminated sand should exhibit an increased count rate in those channels which correspond to the position of the energy peak(s) associated with the contaminants.

Because the X-Met can report assay values for as many as six elements, each scan model consists of assay output for six contiguous bands over the useful range of the spectra. Each independent measurement is designated by the elemental symbol for an element whose major peak falls within that range. This is done because the X-Met will only accept elemental symbols (and BS for backscatter) as valid independent names. Measurement limits are manually defined such that commonly encountered peaks are recorded as an independent; however, counts in each channel within the range are incorporated, without regard to the location of actual element peaks. The internal deconvolution function of the X-Met is side-stepped by manually setting the "G-matrix" or peak overlap factors (1.0 on the diagonal, and

^{*}X-Met is a trademark of Outokumpu Electronics, Inc.

0 elsewhere). This means that the pulse frequencies (gross count rates) and channel intensities (net count rates) reported by the X-Met are equal, i.e., no deconvolution is performed. (The instrument automatically accumulates total counts over the specified range and divides by measurement time to provide an output in counts per second.) The modelling capability of the X-Met is used to define six assay outputs, or dependents, where each dependent is a function of only one independent, with an intercept of 0 and a slope of 1.0. The net effect is that the assay output is the gross count rate for each band. It is not necessary that the name of the assay output be an element symbol. Figures 1 and 2 show a typical background spectra and illustrate the scan model concept applied to measurements made with the Am^{241} and Cm^{244} sources. Table 1 lists the energy ranges for each assay output.

The assay outputs for a "background" or uncontaminated sample represent baseline values. Assay outputs from an unknown sample can be compared to these values: if a significant difference is found in one or more bands, it may indicate the presence of an anomalous amount of an element whose characteristic XRF peak falls within that part of the energy spectrum. If a sufficient number of background samples are available, statistical procedures can be applied to determine a confidence interval for each mean background value. Assay values outside these confidence intervals are then interpreted as indications of anomalies that warrant further evaluation, which could include examination of the XRF spectra and/or laboratory analysis. Table 2 lists background assay values for a wide range of samples analyzed as part of a site-wide background study.

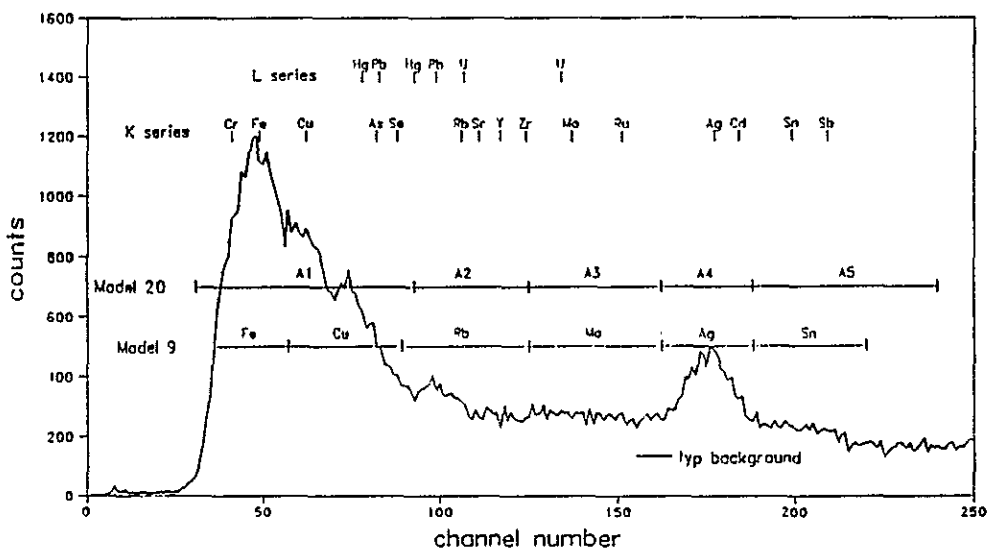


Figure 1. X-MET 880 Scan Models (Am^{241} source).

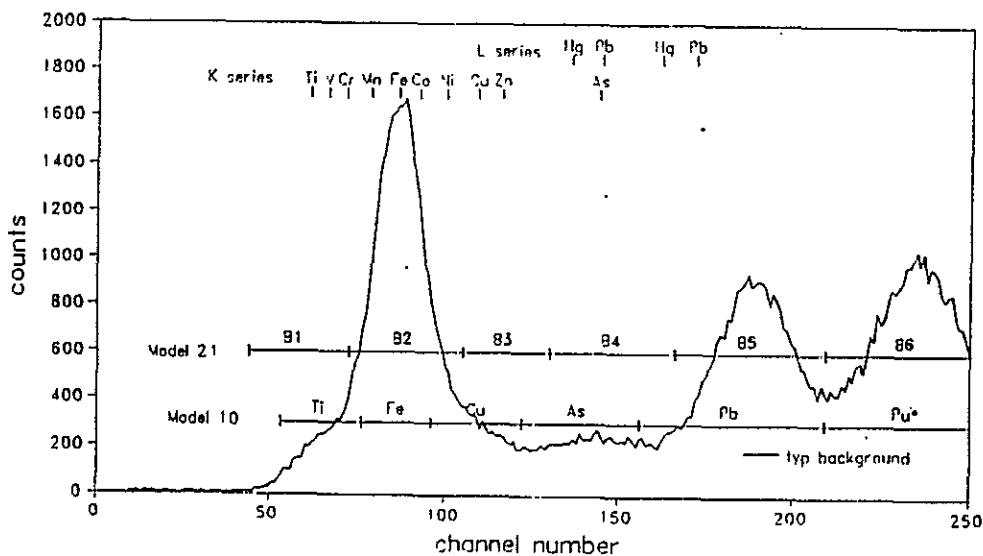


Figure 2. X-MET 880 Scan Models (Cm^{244} source).

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Table 1. X-MET 880 Scan Models.

Model 9: "ASCAN" (Am^{241} source)

Assay	Channels	Energy (KeV)	Elements
Fe	36 - 56	4.8 - 7.3	Cr, Mn, Fe, Co
Cu	57 - 88	7.3 - 11.3	Ni, Cu, Zn, As, Se, Hg, Pb
Rb	89 - 124	11.3 - 15.8	Br, Rb, Sr, Y, Zr, Hg, Pb, U
Mo	125 - 161	15.8 - 20.5	Mo, Ru, U
Ag	162 - 188	20.5 - 23.8	Ag, Cd
Sn	189 - 220	23.8 - 27.8	Sn, Sb

Model 20: "ASCAN1" (Am^{241} source)

Assay	Channels	Energy (KeV)	Elements
A1	31 - 92	4.1 - 11.8	Cr, Mn, Fe, Co, Ni, Zn, As, Se, Hg, Pb
A2	93 - 124	11.8 - 15.8	Br, Rb, Sr, Y, Zr, Hg, Pb, U
A3	125 - 161	15.8 - 20.5	Mo, Ru, U
A4	162 - 188	20.5 - 23.8	Ag, Cd
A5	189 - 240	23.8 - 30.3	Sn, Sb
BS	255	> 32	backscatter

Model 10: "BSCAN" (Cm^{244} source)

Assay	Channels	Energy (KeV)	Elements
Ti	53 - 75	4.0 - 5.6	Ti, V, Cr, Ba
Fe	76 - 96	5.6 - 7.2	Mn, Fe, Co
Cu	97 - 121	7.2 - 8.9	Ni, Cu, Zn
As	122 - 155	8.9 - 11.4	As, Se, Hg, Pb
Pb	156 - 209	11.4 - 15.3	Rb, Sr, Y, Hg, Pb
Pu	210 - 254	15.3 - 18.5	scattering, absorption

Model 21: "BSCAN1" (Cm^{244} source)

Assay	Channels	Energy (KeV)	Elements
B1	44 - 71	3.4 - 5.4	Ti, V, Ba
B2	72 - 104	5.4 - 7.7	Cr, Mn, Fe, Co, Ni
B3	105 - 129	7.7 - 9.5	Cu, Zn
B4	130 - 165	9.5 - 12.1	As, Se, Hg, Pb
B5	166 - 208	12.1 - 15.2	scattering/absorption of secondary X-rays
B6	209 - 254	15.2 - 18.5	

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Table 2. X-MET 880 Scan Models
Summary of Site-Wide Background Values.

Model 9: "ASCAN" 126 samples

	Fe	Cu	Rb	Mo	Ag	Sn
mean	397.7	342.2	188.4	149.6	145.9	102.8
stdev	33.6	7.2	10.2	4.3	4.8	3.4
min	330.7	320.9	168.3	139.9	134.6	95.15
max	475.6	359.7	211.6	161.5	159.4	112.9

Model 10: "BSCAN" 126 samples

	Ti	Fe	Cu	As	Pb	Pu
mean	134.7	774.0	188.9	122.8	422.1	463.0
stdev	24.0	210.1	25.7	9.2	50.0	53.1
min	90.4	387.4	141.1	111.5	336.3	359.8
max	188.9	1281	252.4	158.8	538	575.6

Model 20: "ASCAN1" 114 samples

	A1	A2	A3	A4	A5	BS
mean	781.4	163.9	149.8	146.0	154.7	1762.3
stdev	33.6	9.1	4.2	4.8	5.2	62.7
min	688.2	146.2	139.9	134.6	144.0	1600.8
max	847.7	185.2	161.5	159.4	168.8	1912.4

Model 21: "BSCAN1" 114 samples

	B1	B2	B3	B4	B5	B6	BS
mean	88.9	946.2	110.3	128.2	376.3	464.8	813.1
stdev	13.2	241.0	3.8	11.1	44.6	52.1	15.8
min	64.7	511.4	101.6	116.2	299.6	365.0	777.9
max	120.7	1518.8	118.0	173.8	488.6	582.7	849.4

APPLICATION OF THE SCAN MODEL

In August, 1991, an expedited response action (ERA) was carried out at the 300 Area process trenches to remove uranium contaminated sediments. In conjunction with this effort, the X-Met 880 was used on an experimental basis to investigate the feasibility of the scan model concept. A series of in situ measurements were made along the bottom of the west trench, and along one section up the side slope of the trench. These measurements were made before any sediments were removed, and again after the contaminated soils were removed. In this case model 9 was used and index values were stored in a small battery operated data logger. In this

trench, the primary contaminants were uranium, zirconium and copper deposited by waste water from nuclear fuel processing operations. For uranium, the characteristic energy lines detectable by the X-Met would be the L_{α} and L_{β} lines at 13.613 and 17.218 KeV, respectively. For the Am^{241} source, these lines would center on channels 107 and 134. For Zirconium, the detectable characteristic energy line would be the K_{α} at 15.774 KeV, which corresponds to channel 124. For model 9 (see Figure 1 and Table 1), channels 107 and 124 fall within the Rb range, and channel 134 falls within the Mo range. Hence, elevated levels of either uranium or zirconium would be expressed as anomalous values in the Rb index value. The $U L_{\alpha}$ peak at

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channel 134 would also contribute to elevated values of the Mo index. Because the Zr peaks occurs at the boundary between the Rb and Mo ranges, elevated Zr will also result in elevated Mo index values. This is illustrated in Figure 3, which shows a typical contaminated soil spectra superimposed on a background spectra. The dotted lines show the respective index values. Note that the uranium and zirconium peaks are expressed as significant differences in the Rb and Mo index values.

Figure 4 shows the Rb index data for a profile down the center of the trench. The mean background value is based on measurements from similar soils obtained from a nearby undisturbed location. Note that in situ values observed in the trench prior to the ERA are considerably elevated relative to background, whereas measurements made after the contaminated soil was removed indicate approximate background values.

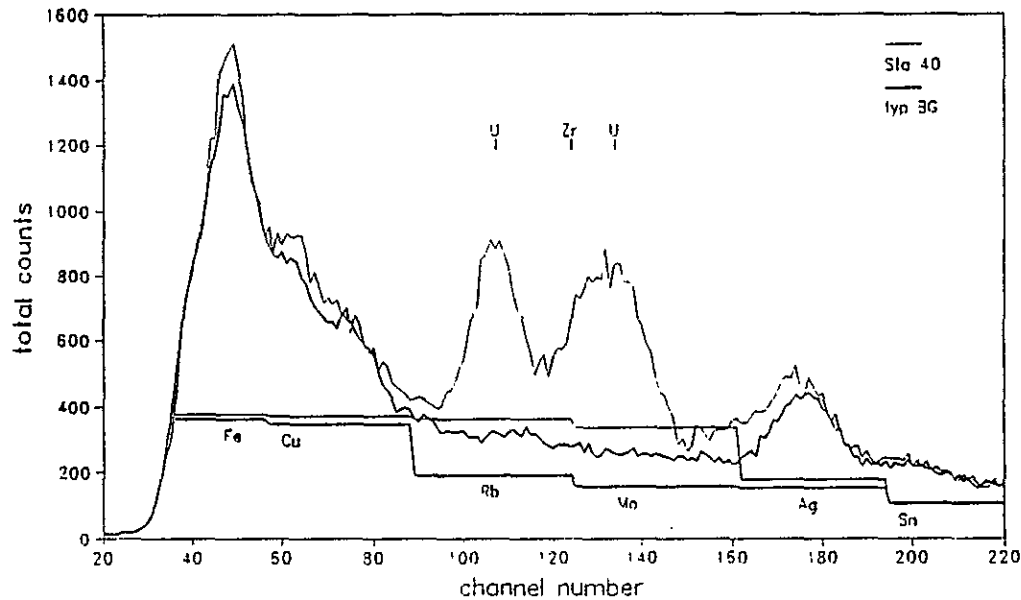


Figure 3. 316-5 Process Trenches, West Trench (In Situ XRF Spectra, Am-241, 60 sec).

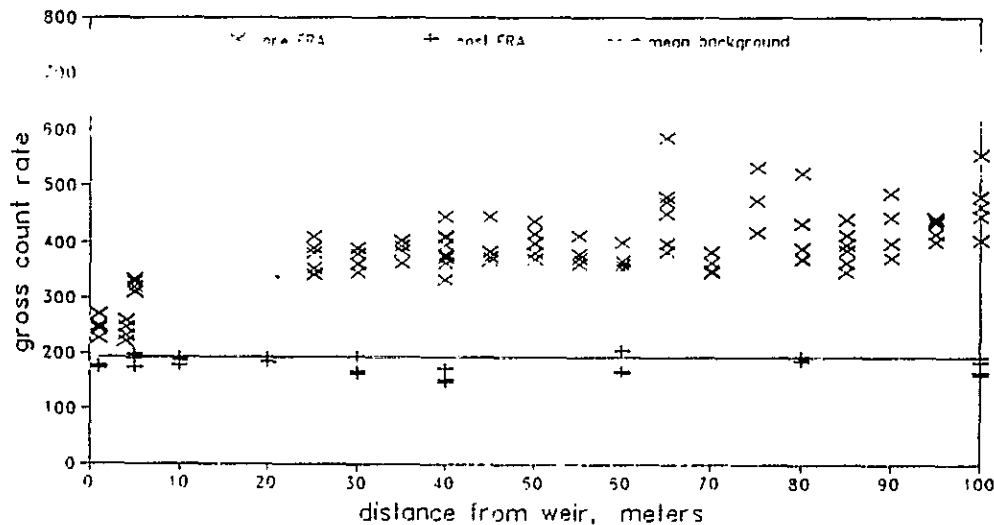


Figure 4. West Process Trench (Model 9, "ASCAN": Rb Index Values).

9 3 1 2 7 3 3 0 5 9 8

CONCLUSIONS

Available data suggest the scan approach can be used with a portable ED-XRF unit such as the X-Met 880 to detect anomalous levels of heavy metal contamination in soils or other surfaces. This approach allows the operator to make a simple measurement and provides criteria for the rapid evaluation of contamination potential, without recourse to spectral display and extensive data evaluation. Obviously, this approach is somewhat limited, because detection limits are necessarily somewhat high.

REFERENCES

1. Environmental Protection Agency, Data Quality Objectives for Remedial Response Activities: Example Scenario: RI/FS Activities at a Site with Contaminated Soils and Ground Water, EPA/540/G-87/004, Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Site Control Division, Washington, D.C. (1987).
2. D. S. KENDALL, "The Application of X-Ray Fluorescence Spectrometry to the Analysis of Hazardous Wastes" in M. S. SIMMONS (editor), Hazardous Waste Measurements, Lewis Publishers, Chelsea, Michigan (1991).
3. G. C. RAAB, R. E. ENWALL, W. H. COLE, III, M. L. FABER, AND L. A. ECCLES, "X-ray Fluorescence Field Method For Screening of Inorganic Contaminants at Hazardous Waste Sites" in M. S. SIMMONS (editor), Hazardous Waste Measurements, Lewis Publishers, Chelsea, Michigan (1991).

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9 3 1 2 7 6 3 0 6 0 0

Field Screening for Heavy Metals with Portable XRF Units

**R.G. McCain & S.J. Guzek
Environmental Remedial Action Group
Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352**

**American Nuclear Society
SPECTRUM '92
Boise, ID
Aug 25, 1992**

Three Levels of Analytical Requirements for Metals¹

Level	Degree of Analytical Requirement			Purpose
	precision	accuracy	IDL	
1 (IV)	$\pm 5\%$	$\pm 10\%$	ppb	Litigation and regulatory enforcement
2 (III)	$\pm 10\%$	$\pm 15\%$	ppm	Evaluate and assess average pollutant exposure to humans and animals
3 (I, II)	$\pm 10\%$	$\pm 50\%$	$\leq 1000\text{ppm}$	Screening, preliminary evaluation and on-site decision- making

¹

Raab, G.A.; D. Cardenas; S.J. Simon & L.A. Eccles (1987); " Evaluation of A Prototype Field-Portable X-Ray Fluorescence System for Hazardous Waste Screening"

Factors Affecting Interpretation of XRF Data

- **Source energy level and excitation efficiency**
- **Detector efficiency and energy resolution capability**
- **Measurement time**
- **Matrix effects:**
 - **Scattering**
 - **Absorption**
- **Interelement effects:**
 - **Peak overlap**
 - **Secondary excitation**
 - **Secondary absorption**

X-Met 880
Analytical Methods

ID Model

- Instrument attempts to find match based on comparison of relative intensities. Output is identification of material.
- Primarily used to identify metal alloys. May also be useful in stratigraphic correlation, and in monitoring cleanup activities.

ASSAY Model

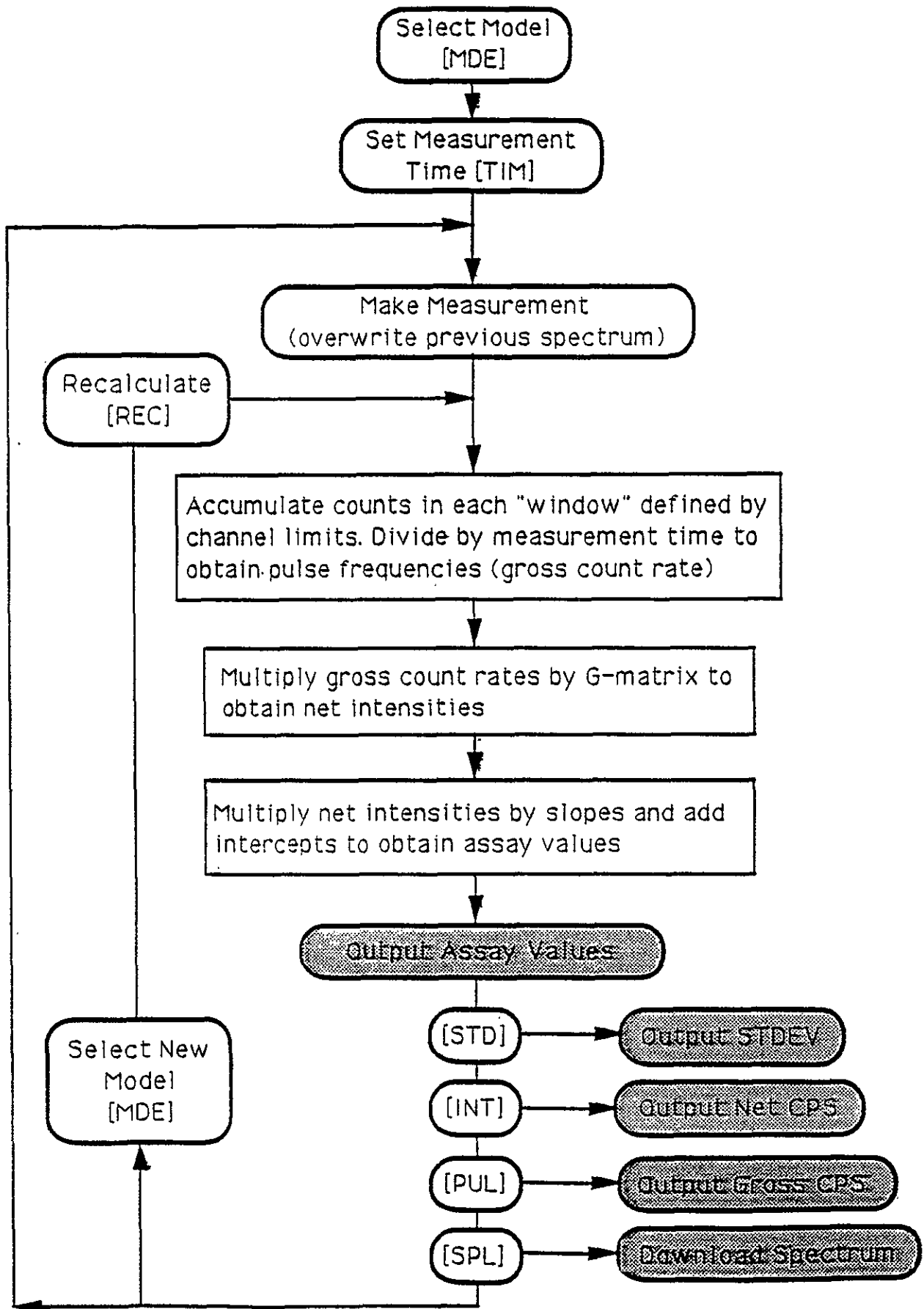
- Instrument computes assay values from XRF intensities based on empirical calibration.
- Types of ASSAY Models
 - **ASSAY**: Output is in concentration values, with empirical calibration based on regression to 20-30 calibration standards. Provides quantitative output.
 - **INDEX**: Output is in net intensity for each element of interest. Provides qualitative output.
 - **SCAN**: Output is gross count rate for six elements which represent adjacent bands over the useful part of the spectrum. All channels within the useful part of the spectrum are accumulated into one of the element bands. Provides a non-specific indication of the possible presence of contamination

Spectral Evaluation

- Download and evaluate spectra
- Contamination detected by comparison of spectra to background. Elements identified by energy level

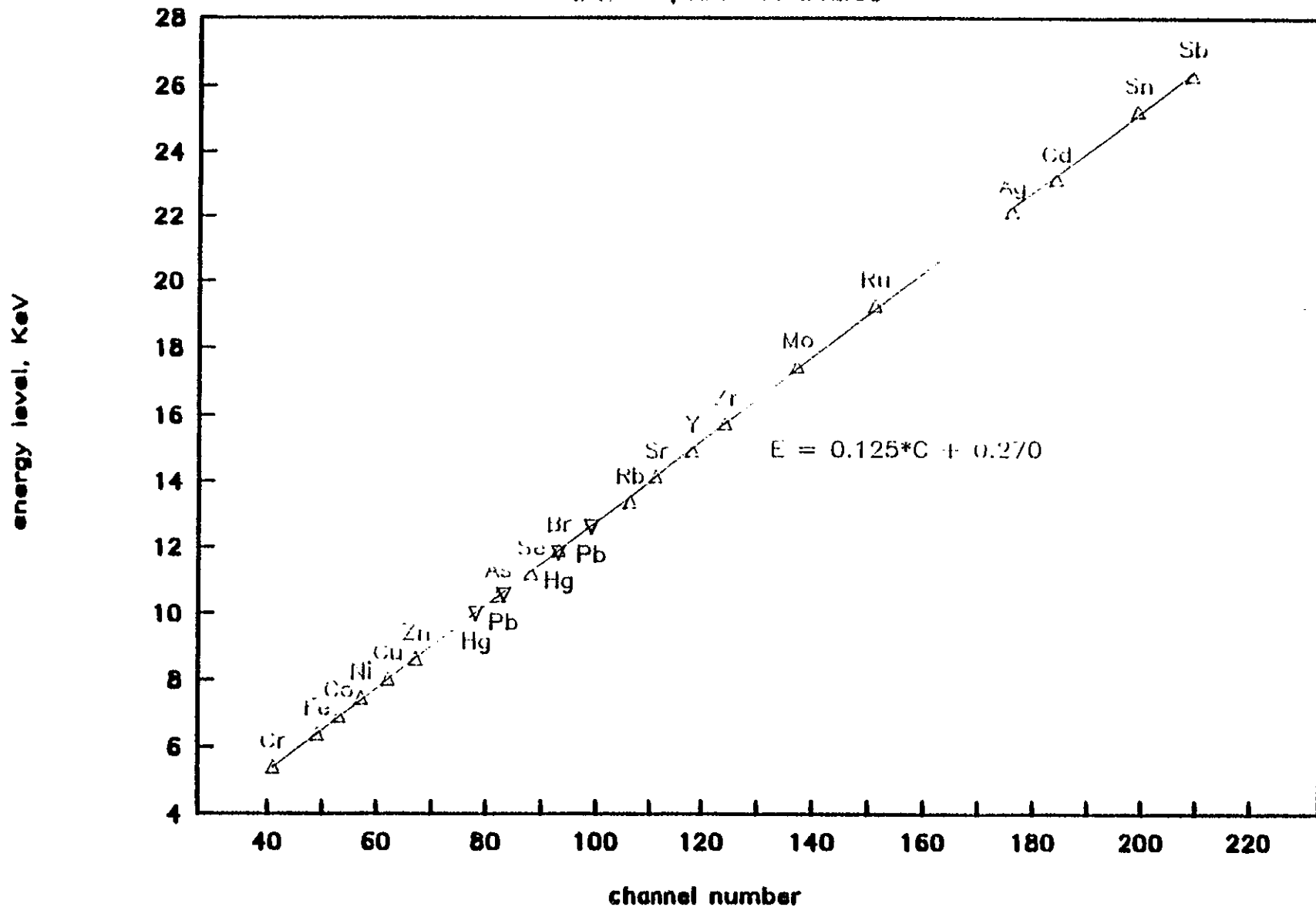
9 3 1 2 7 3 3 0 6 0 3

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Energy Levels and Channel Numbers

X-Met 880, Am 241 Source

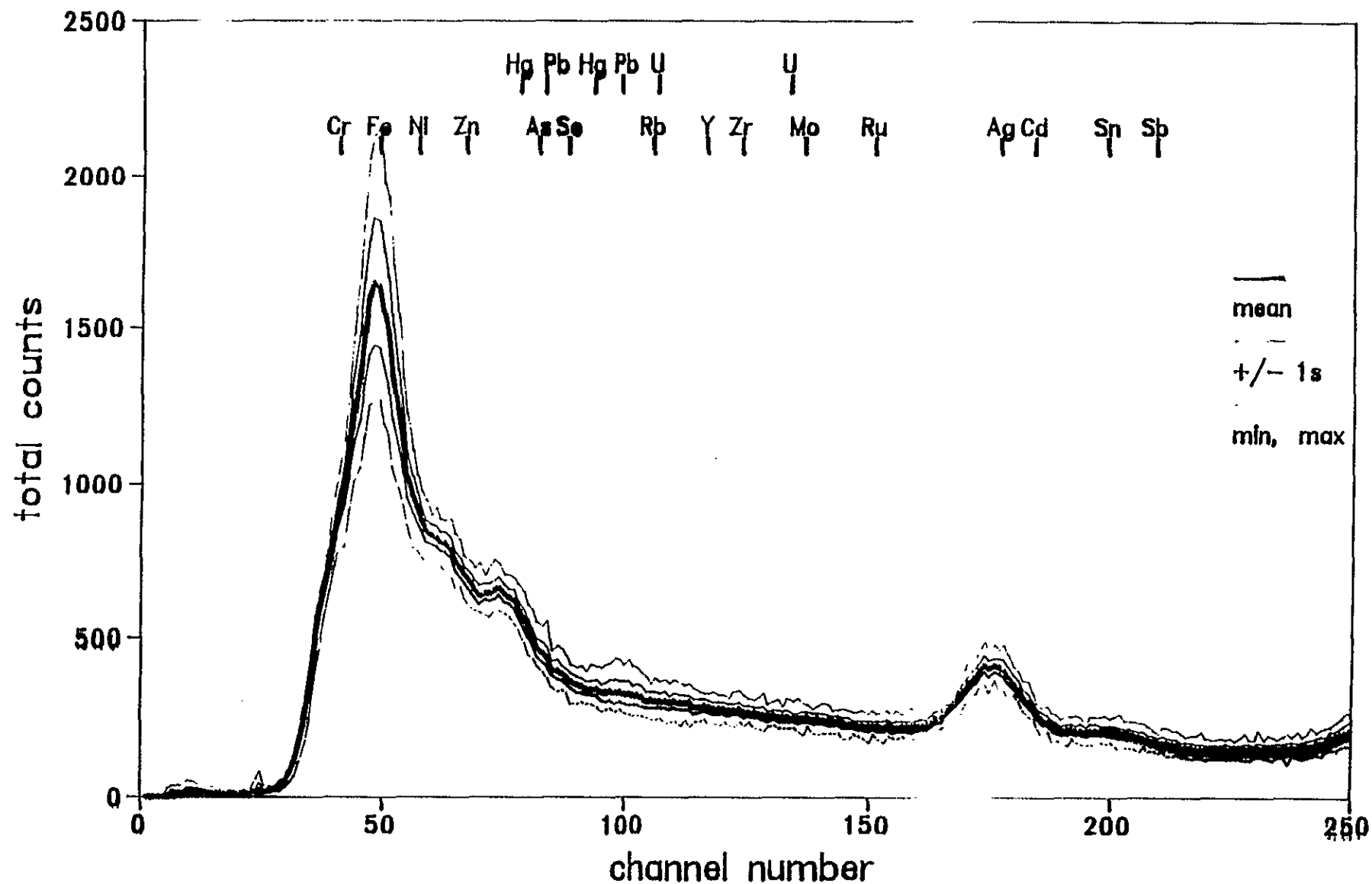


Δ K series ∇ L series

9 3 1 2 7 5 3 0 6 0 6

Site — Wide Background Study

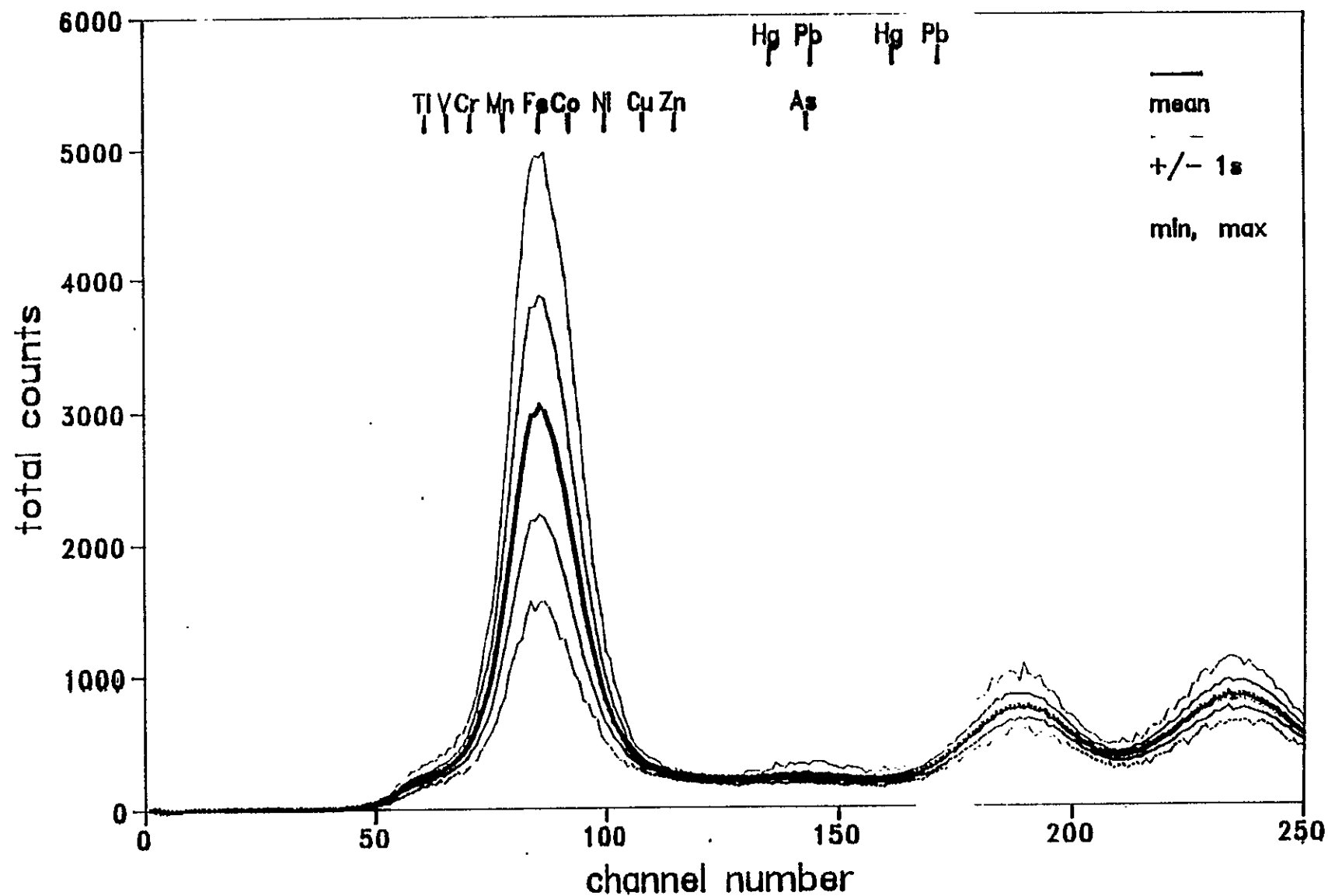
114 Spectra, Am-241 Source



9 3 1 2 7 5 3 0 6 0 7

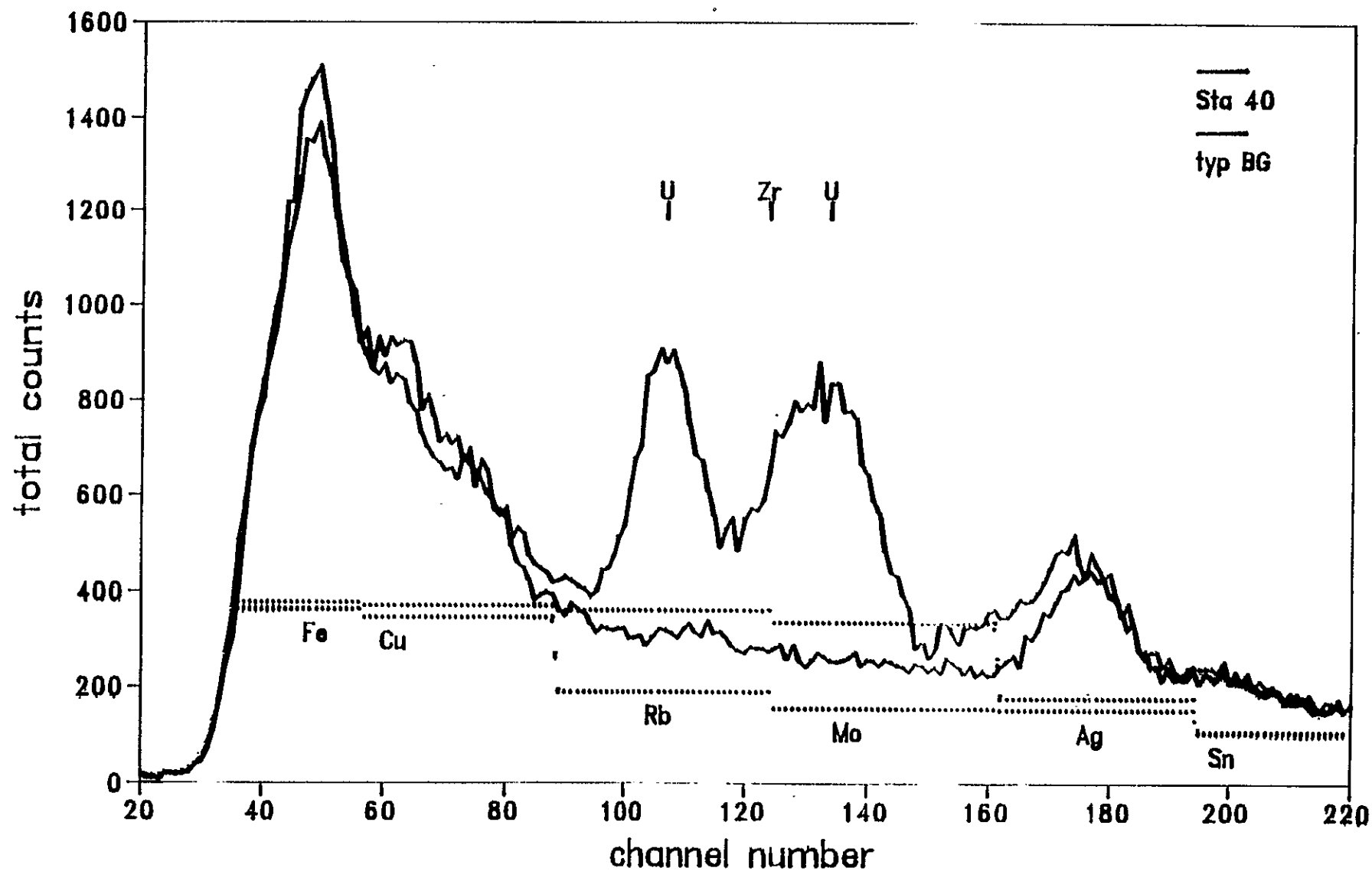
Site — Wide Background Study

114 Spectra, Cm-244 Source



9 3 1 2 7 5 3 0 6 0 8

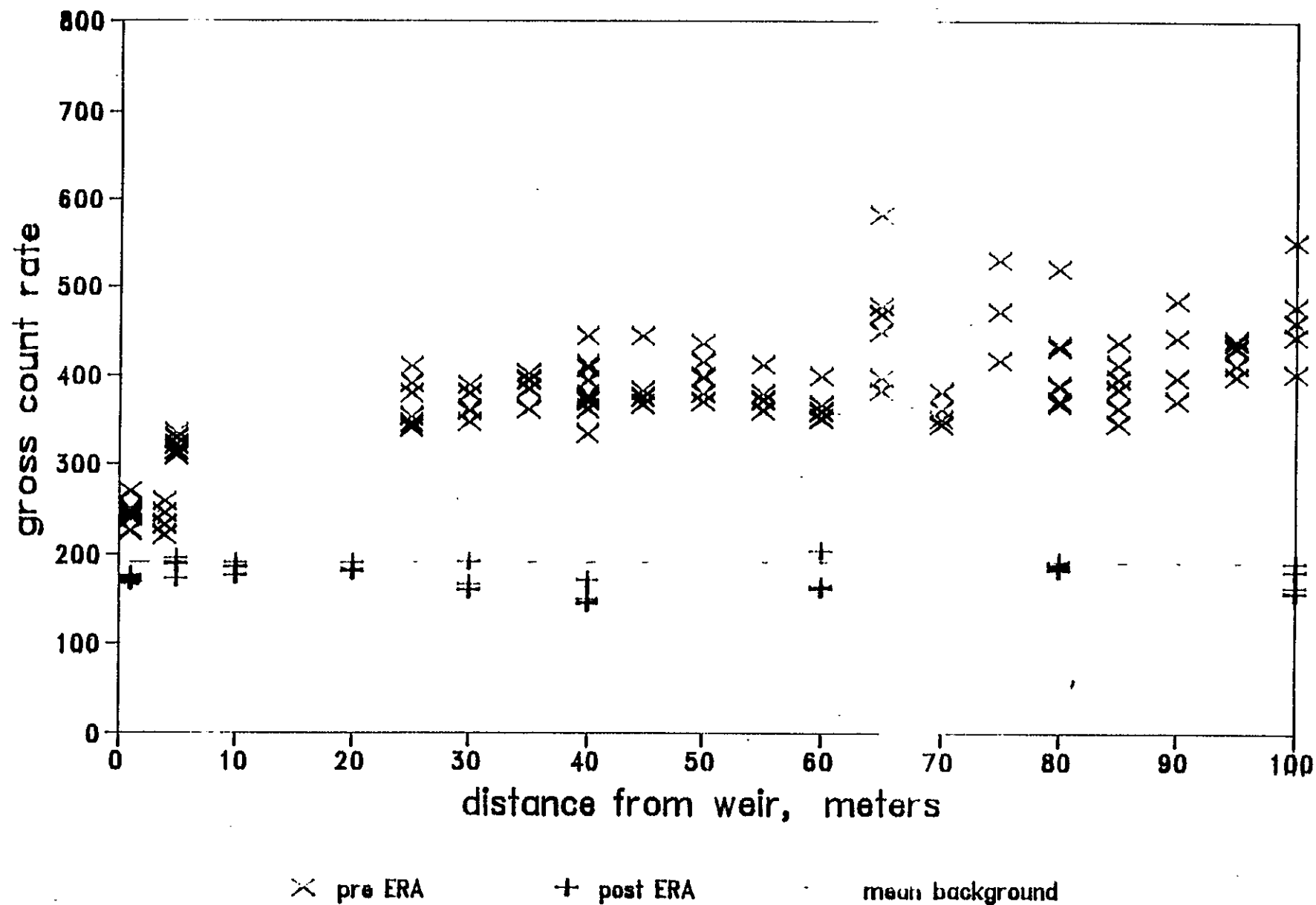
316-5 Process Trenches, West Trench In Situ XRF Spectra, Am-241, 60 sec



9 3 1 2 7 5 3 0 6 0 9

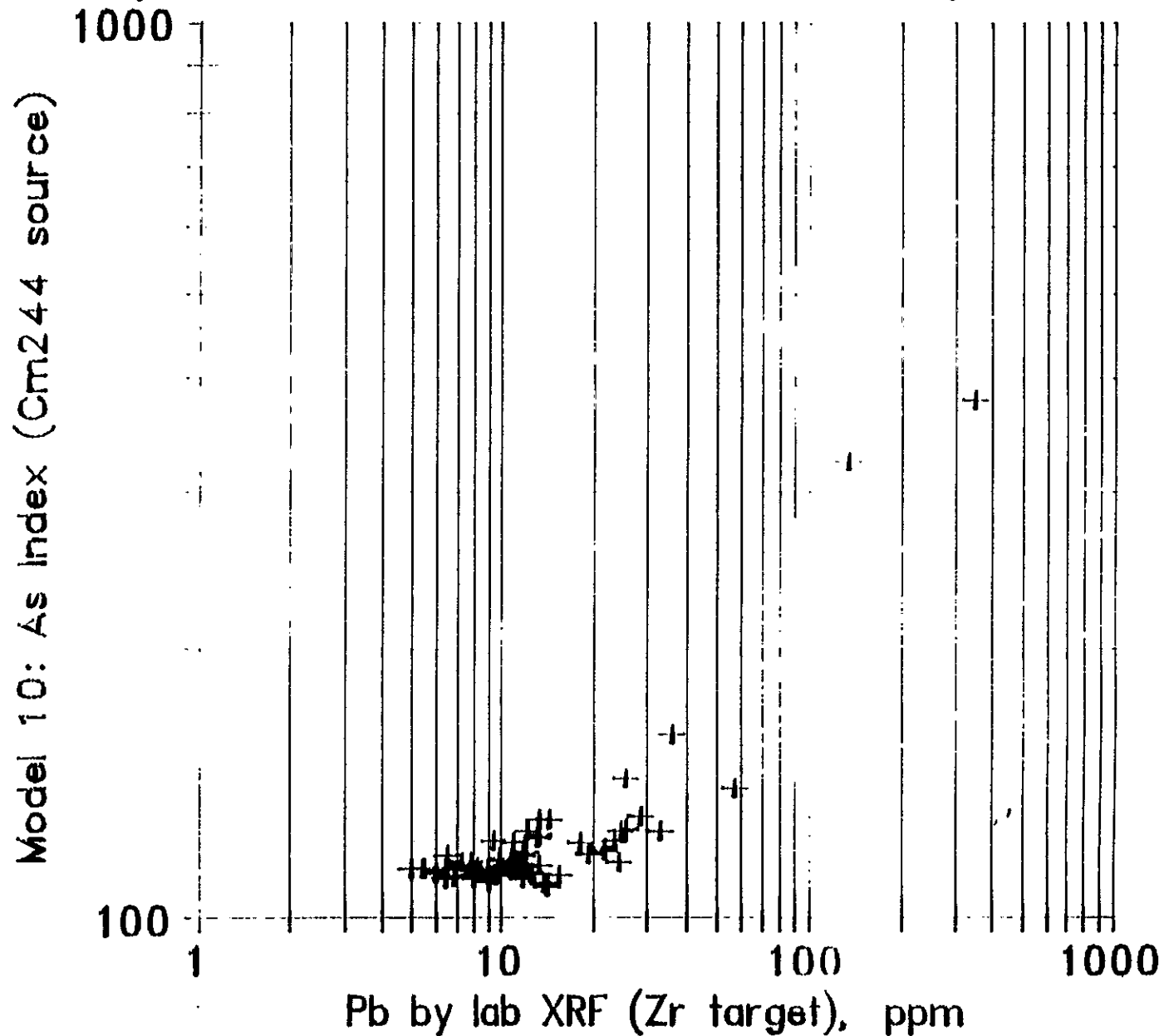
316-5 West Process Trench

Model 9 "ASCAN": Rb Index Values



9 3 1 2 7 5 3 0 6 1 0

Comparison of X-Met with Laboratory XRF



X-RAY FLUORESCENCE SPECTROMETRY SAMPLE DATA

December 10, 1992

Project: PICKLING ACID CRIBSamples collected by: ROBERTO M. ARNOLD & RORY STEFFLERXRF Measurements by: STEVE J. GUZEKMODEL 1 Am²⁴¹ Source

PACBG1 S1A TIM = 60 12/02/92 01:35:56PM Model # 1

ASSAYS:FE 32.86 RB 8.223 ZR 0.769 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.825 RB 1.443 ZR 0.647 U 0.601 CD 0.576 SB 0.44

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
32.86	-5.120	-9.417	8.223	0.769	-3.648	-2.208	-4.482	-2.461	2232

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
103.3	25.52	17.28	18.18	17.38	15.30	13.93	16.78	10.87	2232

PACBG2 S1A TIM = 60 12/02/92 01:45:35PM Model # 1

ASSAYS:FE 22.64 RB 7.306 ZR 0.017 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.767 RB 1.452 ZR 0.639 U 0.606 CD 0.576 SB 0.44

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
22.64	-5.956	-8.714	7.306	0.017	-3.290	-2.964	-4.623	-2.646	2254

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
96.63	25.90	17.67	18.25	16.90	15.60	13.32	16.82	10.62	2254

PACBG3 S1A TIM = 60 12/02/92 01:56:48PM Model # 1

ASSAYS:FE 26.17 RB 6.350 ZR 0.278 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.773 RB 1.442 ZR 0.638 U 0.604 CD 0.585 SB 0.42

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
26.17	-5.933	-8.869	6.350	0.278	-3.000	-2.841	-3.505	-3.260	2204

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
97.42	24.85	16.88	17.45	16.82	15.53	13.13	17.35	9.933	2204

RUST-A S1A TIM = 60 12/02/92 02:04:32PM Model # 1

ASSAYS:FE 12.17 RB 8.332 ZR 1.201 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.660 RB 1.397 ZR 0.637 U 0.583 CD 0.564 SB 0.42

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
12.17	-5.701	-8.549	8.332	1.201	-4.031	-2.026	-4.239	-2.543	2144

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
85.07	24.20	16.37	16.80	16.90	14.35	13.37	16.13	9.917	2144

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B07PY8 S1A TIM = 60 12/02/92 02:13:00PM Model # 1

ASSAYS:FE 11.83 RB 9.595 ZR 0.316 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.676 RB 1.419 ZR 0.632 U 0.587 CD 0.572 SB 0.43

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
11.83	-7.087	-8.763	9.595	0.316	-4.026	-2.038	-4.291	-2.584	2199

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
86.75	23.77	17.18	18.37	16.57	14.57	13.73	16.60	10.18	2199

B07PY9 S1A TIM = 60 12/02/92 02:21:16PM Model # 1

ASSAYS:FE 15.13 RB 6.518 ZR 1.082 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.670 RB 1.464 ZR 0.646 U 0.611 CD 0.568 SB 0.41

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
15.13	-4.490	-8.372	6.518	1.082	-2.083	-2.747	-3.638	-3.074	2112

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
86.15	25.10	16.83	18.55	17.28	15.90	12.62	16.37	9.367	2112

B07PZ1 S1A TIM = 60 12/02/92 02:30:46PM Model # 1

ASSAYS:FE 5.323 RB 6.979 ZR 0.000 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.599 RB 1.405 ZR 0.603 U 0.583 CD 0.569 SB 0.42

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
5.323	-5.793	-7.189	6.979	-0.953	-2.911	-2.945	-3.570	-2.250	2108

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
78.82	25.03	17.12	17.60	14.95	14.50	12.23	16.42	9.967	2108

B07PZ2 S1A TIM = 60 12/02/92 02:41:56PM Model # 1

ASSAYS:FE 12.41 RB 8.144 ZR 2.029 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.675 RB 1.470 ZR 0.666 U 0.613 CD 0.578 SB 0.42

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
12.41	-4.911	-9.137	8.144	2.029	-2.955	-2.766	-3.751	-2.906	2184

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
86.67	25.10	16.97	18.82	18.45	15.92	13.05	16.93	9.883	2184

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B07PZ3 S1A TIM = 60 12/03/92 01:50:27PM Model # 1
 ASSAYS:FE 18.73 RB 5.986 ZR 1.204 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.714 RB 1.447 ZR 0.650 U 0.606 CD 0.569 SB 0.42
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
18.73	-8.760	-6.872	5.986	1.204	-3.010	-1.808	-4.187	-2.960	2171

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
90.85	23.95	17.98	17.43	17.53	15.58	13.90	16.43	9.817	2171

B07PZ4 S1A TIM = 60 12/03/92 01:54:34PM Model # 1
 ASSAYS:FE 7.734 RB 9.143 ZR 1.427 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.532 RB 1.323 ZR 0.604 U 0.546 CD 0.540 SB 0.40
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
7.734	-4.593	-7.258	9.143	1.427	-3.700	-1.556	-3.026	-1.937	1878

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
72.40	21.88	15.22	16.22	15.25	12.53	11.93	14.80	9.017	1878

B07PZ5 S1A TIM = 60 12/03/92 02:02:23PM Model # 1
 ASSAYS:FE 12.84 RB 7.011 ZR 1.115 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.652 RB 1.434 ZR 0.641 U 0.598 CD 0.581 SB 0.44
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
12.84	-6.452	-7.538	7.011	1.115	-2.858	-2.528	-2.897	-1.820	2107

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
84.32	24.15	17.17	17.82	17.02	15.15	12.75	17.10	10.63	2107

B07PZ6 S1A TIM = 60 12/03/92 02:22:39PM Model # 1
 ASSAYS:FE 24.71 RB 6.139 ZR 0.105 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.710 RB 1.389 ZR 0.612 U 0.580 CD 0.557 SB 0.41
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
24.71	-4.878	-7.455	6.139	0.105	-2.895	-1.295	-3.707	-2.750	2042

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
90.63	24.45	16.43	16.48	15.50	14.32	13.48	15.70	9.417	2042

B07PZ7 S1A TIM = 60 12/03/92 02:31:56PM Model # 1
 ASSAYS:FE 9.394 RB 5.535 ZR 0.000 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.528 RB 1.351 ZR 0.582 U 0.561 CD 0.531 SB 0.41
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
9.394	-5.127	-6.072	5.535	-0.177	-1.897	-1.896	-3.141	-1.397	1833

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
72.07	22.02	15.43	16.17	13.95	13.45	11.40	14.32	9.317	1833

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B07PZ8 S1A TIM = 60 12/03/92 02:39:31PM Model # 1

ASSAYS:FE 11.69 RB 9.926 ZR 0.654 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.669 RB 1.449 ZR 0.641 U 0.596 CD 0.577 SB 0.43

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
11.69	-5.684	-8.493	9.926	0.654	-3.422	-2.625	-3.818	-2.589	2179

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
85.97	25.07	17.85	19.75	17.03	15.05	13.08	16.85	10.13	2179

B07PZ9 S1A TIM = 60 12/03/92 02:47:19PM Model # 1

ASSAYS:FE 10.32 RB 6.512 ZR 1.700 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.649 RB 1.432 ZR 0.652 U 0.599 CD 0.558 SB 0.43

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
10.32	-9.820	-6.221	6.512	1.700	-3.360	-2.570	-4.747	-1.978	2150

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
83.98	23.30	18.12	17.22	17.70	15.18	12.93	15.75	10.43	2150

B07Q00 S1A TIM = 60 12/03/92 02:55:29PM Model # 1

ASSAYS:FE 22.83 RB 5.182 ZR 0.065 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.745 RB 1.465 ZR 0.638 U 0.613 CD 0.587 SB 0.43

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
22.83	-6.569	-7.019	5.182	0.065	-2.302	-2.288	-3.217	-2.683	2181

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
94.25	26.02	18.25	18.08	16.78	16.02	13.58	17.47	10.37	2181

B07Q01 S1A TIM = 60 12/08/92 09:22:43AM Model # 1

ASSAYS:FE 12.29 RB 8.899 ZR 0.447 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.731 RB 1.496 ZR 0.661 U 0.622 CD 0.595 SB 0.45

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
12.29	-5.613	-9.847	8.899	0.447	-3.425	-2.635	-4.368	-2.497	2350

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
92.50	26.67	18.00	19.83	18.08	16.43	14.32	17.97	11.18	2350

B07Q03 S1A TIM = 60 12/08/92 09:29:42AM Model # 1

ASSAYS:FE 8.517 RB 7.487 ZR 0.144 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.684 RB 1.465 ZR 0.647 U 0.611 CD 0.592 SB 0.43

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
8.517	-8.349	-8.291	7.487	0.144	-3.411	-1.685	-3.924	-2.942	2287

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
87.52	24.77	17.97	18.45	17.28	15.90	14.78	17.77	10.37	2287

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B07Q04 S1A TIM = 60 12/08/92 10:02:44AM Model # 1
 ASSAYS:FE 12.41 RB 8.303 ZR 1.228 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.761 RB 1.496 ZR 0.679 U 0.626 CD 0.592 SB 0.43
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
12.41	-8.720	-8.786	8.303	1.228	-4.237	-3.284	-5.359	-3.727	2440

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
95.72	26.57	19.07	18.93	19.15	16.57	14.23	17.77	10.37	2440

B07Q06 S1A TIM = 60 12/08/92 10:12:14AM Model # 1
 ASSAYS:FE 10.47 RB 9.170 ZR 0.000 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.711 RB 1.486 ZR 0.649 U 0.616 CD 0.603 SB 0.43
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
10.47	-5.388	-9.739	9.170	-0.111	-3.402	-1.838	-3.584	-3.376	2327

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
90.35	26.57	17.92	19.92	17.42	16.15	14.93	18.43	10.25	2327

B07Q09 S1A TIM = 60 12/08/92 10:23:06AM Model # 1
 ASSAYS:FE 22.82 RB 6.532 ZR 0.794 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.753 RB 1.472 ZR 0.652 U 0.616 CD 0.586 SB 0.44
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
22.82	-7.305	-8.817	6.532	0.794	-2.575	-2.700	-3.557	-2.536	2208

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
95.15	23.83	17.23	18.45	17.57	16.15	13.35	17.40	10.62	2208

B07Q07 S1A TIM = 60 12/08/92 10:30:00AM Model # 1
 ASSAYS:FE 12.80 RB 8.942 ZR 1.056 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.714 RB 1.481 ZR 0.662 U 0.615 CD 0.581 SB 0.44
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
12.80	-7.095	-8.778	8.942	1.056	-3.495	-3.026	-4.661	-2.337	2289

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
90.70	25.45	18.30	19.60	18.18	16.00	13.48	17.12	10.95	2289

B07Q08 S1A TIM = 60 12/08/92 10:36:36AM Model # 1
 ASSAYS:FE 19.40 RB 7.420 ZR 0.000 U 0.000 CD 0.000 SB 0.00
 STDEVS:FE 1.780 RB 1.508 ZR 0.658 U 0.628 CD 0.602 SB 0.44
 CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
19.40	-8.066	-8.611	7.420	-0.018	-2.983	-2.980	-3.956	-3.359	2359

 CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
98.02	26.08	19.00	19.87	17.87	16.78	14.10	18.38	10.58	2359

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B07Q10 S1A TIM = 60 12/08/92 10:43:10AM Model # 1

ASSAYS:FE 14.84 RB 8.696 ZR 1.135 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.722 RB 1.447 ZR 0.655 U 0.604 CD 0.579 SB 0.43

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
14.84	-3.803	-9.761	8.696	1.135	-3.936	-2.922	-4.610	-2.712	2273

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
91.60	26.90	16.98	18.08	17.87	15.45	13.43	16.98	10.52	2273

B07Q11 S1A TIM = 60 12/08/92 10:49:58AM Model # 1

ASSAYS:FE 16.62 RB 6.825 ZR 0.000 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.748 RB 1.476 ZR 0.644 U 0.617 CD 0.590 SB 0.42

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
16.62	-7.440	-8.968	6.825	-0.296	-3.059	-3.031	-4.246	-3.786	2315

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
94.38	25.35	17.78	18.57	17.12	16.25	13.68	17.65	9.800	2315

B07Q1213 S1A TIM = 60 12/08/92 10:57:15AM Model # 1

ASSAYS:FE 18.57 RB 10.14 ZR 1.167 U 0.000 CD 0.000 SB 0.00

STDEVS:FE 1.725 RB 1.388 ZR 0.639 U 0.574 CD 0.568 SB 0.41

CHANNEL INTENSITIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
18.57	-6.374	-8.407	10.14	1.167	-5.043	-2.463	-4.600	-3.673	2211

CHANNEL PULSE FREQUENCIES: (MODEL 1: A3)

FE	AS	PB	RB	ZR	U	RU	CD	SB	BS
92.05	24.93	17.45	17.33	17.07	13.87	13.33	16.33	9.250	2211

MODEL 7 Am²⁴¹ Source

PACBG1 S1A TIM = 60 12/02/92 01:35:56PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
459.4	196.2	203.0	139.6	129.5	107.2	166.8	88.18	111.1	2232

PACBG2 S1A TIM = 60 12/02/92 01:45:35PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
432.1	195.5	200.3	140.0	126.9	109.3	169.7	87.05	109.8	2254

PACBG3 S1A TIM = 60 12/02/92 01:56:48PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
437.1	189.6	195.4	137.7	123.2	104.9	165.1	83.17	108.9	2204

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RUST-A S1A TIM = 60 12/02/92 02:04:32PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
394.1	184.4	189.1	133.2	119.1	106.3	164.7	80.77	110.7	2144

B07PY8 S1A TIM = 60 12/02/92 02:13:00PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
403.7	190.1	194.4	138.9	121.9	108.7	164.3	85.62	113.5	2199

B07PY9 S1A TIM = 60 12/02/92 02:21:16PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
389.5	182.5	190.3	138.0	123.5	103.7	162.1	81.43	109.1	2112

B07PZ1 S1A TIM = 60 12/02/92 02:30:46PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
370.1	179.6	191.3	133.3	115.3	102.3	160.8	82.38	107.7	2108

B07PZ2 S1A TIM = 60 12/02/92 02:41:56PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
395.8	188.4	195.7	140.1	128.5	106.2	166.0	83.45	112.5	2184

B07PZ3 S1A TIM = 60 12/02/92 02:49:52PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
412.6	190.7	198.6	141.2	124.3	105.8	165.0	84.82	108.7	2190

B07PZ4 S1A TIM = 60 12/03/92 01:54:34PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
338.5	165.7	176.2	122.7	108.6	92.55	140.9	74.40	100.2	1878

B07PZ5 S1A TIM = 60 12/03/92 02:02:23PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
388.1	187.1	197.7	138.5	123.9	103.7	161.9	83.47	109.9	2107

B07PZ6 S1A TIM = 60 12/03/92 02:22:39PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
398.3	178.3	186.5	128.8	116.0	101.6	154.8	80.57	105.9	2042

B07PZ7 S1A TIM = 60 12/03/92 02:31:56PM Model # 7

CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)

FE	CU	AS	RB	ZR	RU	AG	SN	SB	BS
340.0	163.2	175.0	118.6	104.3	90.58	141.4	73.28	95.50	1833

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93127530618

B07PZ8 S1A TIM = 60 12/03/92 02:39:31PM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
393.9 188.5 197.0 145.3 125.0 105.6 165.5 85.33 113.3 2179

B07PZ9 S1A TIM = 60 12/03/92 02:47:19PM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
388.8 184.8 191.1 136.9 124.2 104.7 166.1 83.20 112.4 2150

B07Q00 S1A TIM = 60 12/03/92 02:55:29PM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
429.1 190.9 199.7 139.9 123.1 105.7 167.1 86.18 108.1 2181

B07Q01 S1A TIM = 60 12/08/92 09:22:43AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
426.1 200.2 203.3 148.1 132.7 111.4 176.3 88.18 117.6 2350

B07Q03 S1A TIM = 60 12/08/92 09:29:42AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
406.4 191.0 200.6 143.8 125.9 111.6 171.5 86.45 113.5 2287

B07Q04 S1A TIM = 60 12/08/92 10:02:44AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
436.4 204.5 206.2 151.0 139.8 114.5 181.6 91.43 120.4 2440

B07Q06 S1A TIM = 60 12/08/92 10:12:14AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
421.2 196.4 204.3 145.5 132.6 112.5 173.3 89.13 118.1 2327

B07Q09 S1A TIM = 60 12/08/92 10:23:06AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
430.4 191.3 197.1 137.3 127.8 104.8 169.1 84.58 113.3 2208

B07Q07 S1A TIM = 60 12/08/92 10:30:00AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
424.6 203.2 208.0 142.9 132.4 109.5 168.8 87.67 117.4 2289

B07Q08 S1A TIM = 60 12/08/92 10:36:36AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
443.2 211.5 208.9 150.6 134.2 114.0 173.9 86.90 117.7 2359

B07Q10 S1A TIM = 60 12/08/92 10:43:10AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
419.5 194.3 203.0 141.0 129.0 107.5 172.7 86.37 113.3 2273

B07Q11 S1A TIM = 60 12/08/92 10:49:58AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
431.5 198.0 202.4 144.3 132.1 112.2 172.8 86.55 116.0 2315

B07Q1213 S1A TIM = 60 12/08/92 10:57:15AM Model # 7
CHANNEL PULSE FREQUENCIES: (MODEL 7: ASCAN10)
FE CU AS RB ZR RU AG SN SB BS
412.5 186.5 193.8 138.4 124.7 104.9 164.3 84.22 109.8 2211

MODEL 9 Am²⁴¹ Source

PACBG1 S1A TIM = 60 12/02/92 01:35:56PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
501.3 391.1 221.6 181.8 182.1 121.3 2232

PACBG2 S1A TIM = 60 12/02/92 01:45:35PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
473.7 388.3 219.3 183.4 183.2 122.0 2254

PACBG3 S1A TIM = 60 12/02/92 01:56:48PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
479.3 377.0 213.9 177.4 179.2 116.8 2204

RUST-A S1A TIM = 60 12/02/92 02:04:32PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
435.4 367.7 204.8 176.8 178.2 116.0 2144

B07PY8 S1A TIM = 60 12/02/92 02:13:00PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
445.1 376.3 216.0 179.0 178.4 120.0 2199

B07PY9 S1A TIM = 60 12/02/92 02:21:16PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
428.6 364.2 213.5 176.7 176.3 114.0 2112

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B07PZ1 S1A TIM = 60 12/02/92 02:30:46PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
408.3	363.3	203.6	172.1	173.9	115.8	2108

B07PZ2 S1A TIM = 60 12/02/92 02:41:56PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
438.1	375.0	219.2	181.8	180.5	116.0	2184

B07PZ3 S1A TIM = 60 12/02/92 02:49:52PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
452.3	381.4	220.1	177.3	179.6	117.6	2190

B07PZ4 S1A TIM = 60 12/03/92 01:54:34PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
371.4	334.4	192.8	154.3	153.5	106.1	1878

B07PZ5 S1A TIM = 60 12/03/92 02:02:23PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
424.6	377.3	214.1	177.1	175.4	116.0	2107

B07PZ6 S1A TIM = 60 12/03/92 02:22:39PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
436.3	355.6	201.5	170.0	168.4	112.6	2042

B07PZ7 S1A TIM = 60 12/03/92 02:31:56PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
372.0	329.6	184.6	152.9	154.5	101.6	1833

B07PZ8 S1A TIM = 60 12/03/92 02:39:31PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
434.8	377.4	222.7	178.8	180.3	118.0	2179

B07PZ9 S1A TIM = 60 12/03/92 02:47:19PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
426.4	367.8	214.2	176.9	180.0	117.0	2150

B07Q00 S1A TIM = 60 12/03/92 02:55:29PM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)

FE	CU	RB	MO	AG	SN	BS
467.9	384.6	214.3	179.2	182.2	118.8	2181

93127530620

B07Q01 S1A TIM = 60 12/08/92 09:22:43AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
470.1 396.1 228.8 189.4 191.4 123.6 2350

B07Q03 S1A TIM = 60 12/08/92 09:29:42AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
446.2 382.7 221.5 185.7 185.4 121.8 2287

B07Q04 S1A TIM = 60 12/08/92 10:02:44AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
481.0 402.5 236.8 196.1 197.7 126.8 2440

B07Q06 S1A TIM = 60 12/08/92 10:12:14AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
464.8 392.8 226.4 190.5 187.5 125.2 2327

B07Q09 S1A TIM = 60 12/08/92 10:23:06AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
473.3 381.4 215.2 180.6 182.9 119.1 2208

B07Q07 S1A TIM = 60 12/08/92 10:30:00AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
469.4 401.6 227.1 185.7 183.5 123.5 2289

B07Q08 S1A TIM = 60 12/08/92 10:36:36AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
490.2 410.6 232.7 193.6 188.5 122.2 2359

B07Q10 S1A TIM = 60 12/08/92 10:43:10AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
461.7 389.4 220.4 183.6 187.2 121.9 2273

B07Q11 S1A TIM = 60 12/08/92 10:49:58AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
477.6 393.3 223.9 191.0 187.8 121.6 2315

B07Q1213 S1A TIM = 60 12/08/92 10:57:15AM Model # 9
CHANNEL PULSE FREQUENCIES: (MODEL 9: ASCAN)
FE CU RB MO AG SN BS
455.8 373.2 215.2 177.3 178.0 118.4 2211

93127530621

MODEL 20 Am²⁴¹ Source

PACBG1 S1A TIM = 60 12/02/92 01:35:56PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
934.2 194.4 181.8 182.1 184.0 2232

PACBG2 S1A TIM = 60 12/02/92 01:45:35PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
902.1 192.7 183.4 183.2 183.4 2254

PACBG3 S1A TIM = 60 12/02/92 01:56:48PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
896.1 188.4 177.4 179.2 178.0 2204

RUST-A S1A TIM = 60 12/02/92 02:04:32PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
839.8 181.7 176.8 178.2 177.9 2144

B07PY8 S1A TIM = 60 12/02/92 02:13:00PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
861.0 190.5 179.0 178.4 185.1 2199

B07PY9 S1A TIM = 60 12/02/92 02:21:16PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
831.2 188.4 176.7 176.3 176.4 2112

B07PZ1 S1A TIM = 60 12/02/92 02:30:46PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
809.6 178.9 172.1 173.9 177.0 2108

B07PZ2 S1A TIM = 60 12/02/92 02:41:56PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
853.4 193.0 181.8 180.5 181.4 2184

B07PZ3 S1A TIM = 60 12/03/92 01:50:27PM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)
FE RB MO AG SN BS
850.5 187.6 178.5 178.5 177.0 2171

93127530622

B07PZ4 S1A TIM = 60 12/03/92 01:54:34PM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
739.5	169.6	154.3	153.5	162.0	1878

B07PZ5 S1A TIM = 60 12/03/92 02:02:23PM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
839.5	189.0	177.1	175.4	179.9	2107

B07PZ6 S1A TIM = 60 12/03/92 02:22:39PM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
829.5	176.4	170.0	168.4	172.8	2042

B07PZ7 S1A TIM = 60 12/03/92 02:31:56PM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
737.2	160.6	152.9	154.5	155.7	1833

B07PZ8 S1A TIM = 60 12/03/92 02:39:31PM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
852.2	197.0	178.8	180.3	183.8	2179

B07PZ9 S1A TIM = 60 12/03/92 02:47:19PM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
831.6	188.9	176.9	180.0	181.7	2150

B07Q00 S1A TIM = 60 12/03/92 02:55:29PM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
890.3	189.5	179.2	182.2	179.1	2181

B07Q01 S1A TIM = 60 12/08/92 09:22:43AM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
907.0	202.9	189.4	191.4	190.7	2350

B07Q03 S1A TIM = 60 12/08/92 09:29:42AM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
869.9	195.5	185.7	185.4	186.2	2287

B07Q04 S1A TIM = 60 12/08/92 10:02:44AM Model # 20

CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
926.7	209.1	196.1	197.7	195.6	2440

93127530623

B07Q06 S1A TIM = 60 12/08/92 10:12:14AM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
900.4	200.2	190.5	187.5	193.0	2327

B07Q09 S1A TIM = 60 12/08/92 10:23:06AM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
896.2	189.3	180.6	182.9	184.0	2208

B07Q07 S1A TIM = 60 12/08/92 10:30:00AM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
914.2	199.2	185.7	183.5	190.4	2289

B07Q08 S1A TIM = 60 12/08/92 10:36:36AM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
945.5	205.3	193.6	188.5	190.0	2359

B07Q10 S1A TIM = 60 12/08/92 10:43:10AM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
892.7	193.9	183.6	187.2	185.3	2273

B07Q11 S1A TIM = 60 12/08/92 10:49:58AM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
913.5	197.6	191.0	187.8	187.5	2315

B07Q1213 S1A TIM = 60 12/08/92 10:57:15AM Model # 20
CHANNEL PULSE FREQUENCIES: (MODEL20: ASCAN1)

FE	RB	MO	AG	SN	BS
868.8	190.7	177.3	178.0	180.3	2211

93127530624

MODEL 2 Cm²⁴⁴ Source

PACBG1 S1B TIM = 60 12/02/92 01:40:01PM Model # 2

ASSAYS:CR 0.000 FE 138.2 CU 0.000 ZN 0.000 AS 4.666 PB 0.00

STDEVS:CR 2.149 FE 1.909 CU 1.740 ZN 1.115 AS 1.203 PB 0.63

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
4.007	-1.522	-0.782	138.2	2.364	-8.501	-0.908	4.666	-3.932	794.4

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
12.10	15.88	27.35	158.6	42.30	16.47	12.88	9.400	15.03	794.4

PACBG2 S1B TIM = 60 12/02/92 01:49:19PM Model # 2

ASSAYS:CR 0.000 FE 114.7 CU 0.000 ZN 0.000 AS 2.998 PB 0.00

STDEVS:CR 2.047 FE 1.773 CU 1.693 ZN 1.087 AS 1.246 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
-0.662	3.196	-3.066	114.7	0.729	-6.737	-2.771	2.998	-2.789	811.0

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.08	15.07	24.40	136.2	37.52	16.18	12.10	10.07	16.42	811.0

PACBG3 S1B TIM = 60 12/02/92 02:00:27PM Model # 2

ASSAYS:CR 0.000 FE 127.9 CU 0.000 ZN 0.000 AS 3.886 PB 0.00

STDEVS:CR 2.061 FE 1.842 CU 1.701 ZN 1.087 AS 1.224 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
0.288	5.067	-6.247	127.9	1.466	-7.480	-2.013	3.886	-3.361	791.8

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
11.55	15.63	24.07	147.6	39.82	15.95	12.10	9.683	15.73	791.8

RUST-A S1B TIM = 60 12/02/92 02:08:31PM Model # 2

ASSAYS:CR 0.000 FE 93.07 CU 0.000 ZN 0.000 AS 1.306 PB 0.00

STDEVS:CR 1.932 FE 1.635 CU 1.649 ZN 1.072 AS 1.238 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
0.261	0.938	-1.582	93.07	0.099	-5.864	-2.874	1.306	-1.782	789.7

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.267	13.42	21.73	115.3	32.93	15.77	11.92	9.817	16.42	789.7

B07PY8 S1B TIM = 60 12/02/92 02:16:36PM Model # 2

ASSAYS:CR 0.000 FE 91.50 CU 0.000 ZN 0.000 AS 1.991 PB 0.00

STDEVS:CR 1.978 FE 1.631 CU 1.630 ZN 1.060 AS 1.242 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
-0.574	3.305	-2.406	91.50	1.039	-7.460	-2.548	1.991	-2.271	804.1

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.02	14.62	22.23	114.2	33.12	15.20	11.70	9.883	16.43	804.1

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B07PY9 S1B TIM = 60 12/02/92 02:25:22PM Model # 2

ASSAYS:CR 2.595 FE 85.47 CU 0.000 ZN 0.000 AS 0.538 PB 0.00

STDEVS:CR 1.946 FE 1.600 CU 1.650 ZN 1.074 AS 1.258 PB 0.66

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
3.249	-4.284	2.595	85.47	1.920	-7.521	-2.689	0.538	-1.227	810.7

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.683	13.13	22.55	109.8	33.10	15.78	11.98	10.27	16.95	810.7

B07PZ1 S1B TIM = 60 12/02/92 02:34:37PM Model # 2

ASSAYS:CR 0.381 FE 78.13 CU 0.000 ZN 0.000 AS 1.418 PB 0.00

STDEVS:CR 1.857 FE 1.542 CU 1.645 ZN 1.072 AS 1.229 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
2.230	-2.659	0.381	78.13	1.186	-6.155	-3.258	1.418	-1.871	802.9

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.117	12.20	20.22	102.2	31.48	16.02	11.85	9.883	16.20	802.9

B07PZ2 S1B TIM = 60 12/02/92 02:45:44PM Model # 2

ASSAYS:CR 0.000 FE 86.73 CU 0.000 ZN 0.000 AS 0.386 PB 0.00

STDEVS:CR 1.901 FE 1.597 CU 1.648 ZN 1.072 AS 1.282 PB 0.67

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
-1.481	4.844	-4.845	86.73	2.914	-8.277	-2.322	0.386	-1.007	808.9

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.633	13.78	20.15	109.7	33.82	15.60	11.95	10.63	17.67	808.9

B07PZ3 S1B TIM = 60 12/02/92 02:55:11PM Model # 2

ASSAYS:CR 0.177 FE 98.37 CU 0.000 ZN 0.000 AS 2.515 PB 0.00

STDEVS:CR 1.974 FE 1.676 CU 1.678 ZN 1.108 AS 1.226 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
1.202	-1.177	0.177	98.37	2.031	-8.903	-0.400	2.515	-2.579	803.5

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.350	13.55	23.17	121.4	34.92	15.88	13.22	9.817	15.97	803.5

B07PZ4 S1B TIM = 60 12/03/92 01:58:26PM Model # 2

ASSAYS:CR 0.447 FE 76.00 CU 0.000 ZN 0.000 AS 0.667 PB 0.00

STDEVS:CR 1.891 FE 1.525 CU 1.592 ZN 1.038 AS 1.250 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
1.459	-0.967	0.447	76.00	-0.152	-5.847	-3.584	0.667	-1.084	788.8

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.350	13.02	20.68	99.40	29.55	14.95	11.15	10.35	16.70	788.8

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B07PZ5 S1B TIM = 60 12/03/92 02:05:56PM Model # 2

ASSAYS:CR 0.806 FE 88.03 CU 0.000 ZN 0.000 AS 0.000 PB 0.00

STDEVS:CR 1.926 FE 1.610 CU 1.650 ZN 1.080 AS 1.261 PB 0.66

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
2.891	-2.973	0.806	88.03	-0.747	-5.567	-3.136	-0.393	-0.939	808.0

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.767	13.03	21.85	111.5	31.78	15.95	12.17	9.833	17.20	808.0

B07PZ6 S1B TIM = 60 12/03/92 02:26:42PM Model # 2

ASSAYS:CR 0.000 FE 94.00 CU 0.000 ZN 0.000 AS 0.974 PB 0.00

STDEVS:CR 1.932 FE 1.638 CU 1.624 ZN 1.046 AS 1.253 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
0.760	0.838	-1.793	94.00	-1.128	-4.753	-4.079	0.974	-1.273	785.6

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.583	13.48	21.62	115.8	32.23	15.37	11.12	10.30	16.78	785.6

B07PZ7 S1B TIM = 60 12/03/92 02:35:34PM Model # 2

ASSAYS:CR 1.745 FE 76.45 CU 0.000 ZN 0.000 AS 0.622 PB 0.00

STDEVS:CR 1.904 FE 1.530 CU 1.549 ZN 1.031 AS 1.246 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
0.576	-1.366	1.745	76.45	1.120	-9.624	-1.049	0.622	-1.132	787.3

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
8.467	12.83	21.47	100.1	29.25	13.52	11.60	10.25	16.63	787.3

B07PZ8 S1B TIM = 60 12/03/92 02:43:11PM Model # 2

ASSAYS:CR 2.535 FE 74.10 CU 0.000 ZN 0.000 AS 2.382 PB 0.00

STDEVS:CR 1.902 FE 1.521 CU 1.578 ZN 1.045 AS 1.229 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
2.830	-3.721	2.535	74.10	1.010	-8.929	-1.753	2.382	-2.177	808.7

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.417	12.80	21.32	98.82	29.55	14.28	11.75	10.38	15.98	808.7

B07PZ9 S1B TIM = 60 12/03/92 02:51:01PM Model # 2

ASSAYS:CR 0.000 FE 86.48 CU 0.000 ZN 0.000 AS 0.358 PB 0.00

STDEVS:CR 1.887 FE 1.596 CU 1.609 ZN 1.056 AS 1.270 PB 0.66

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
-0.173	1.137	-2.222	86.48	0.011	-7.620	-2.451	0.358	-1.119	812.6

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
8.900	12.87	20.63	109.7	31.40	14.83	11.82	10.40	17.40	812.6

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B07Q00 S1B TIM = 60 12/03/92 02:59:19PM Model # 2

ASSAYS:CR 0.905 FE 118.5 CU 0.000 ZN 0.000 AS 1.260 PB 0.00

STDEVS:CR 2.079 FE 1.797 CU 1.670 ZN 1.057 AS 1.251 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
3.609	-2.569	0.905	118.5	1.643	-7.042	-3.316	1.260	-1.636	788.0

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
11.05	14.88	25.72	140.0	38.35	15.55	11.17	9.950	16.62	788.0

B07Q01 S1B TIM = 60 12/08/92 09:25:54AM Model # 2

ASSAYS:CR 0.000 FE 104.4 CU 0.000 ZN 0.000 AS 2.437 PB 0.00

STDEVS:CR 1.935 FE 1.707 CU 1.652 ZN 1.077 AS 1.236 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
2.030	0.022	-3.107	104.4	0.738	-8.107	-1.725	2.437	-2.416	806.2

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.27	13.32	21.68	126.5	35.03	15.32	12.25	10.05	16.25	806.2

B07Q03 S1B TIM = 60 12/08/92 09:32:41AM Model # 2

ASSAYS:CR 0.000 FE 86.90 CU 0.000 ZN 0.000 AS 3.278 PB 0.00

STDEVS:CR 1.887 FE 1.598 CU 1.613 ZN 1.060 AS 1.213 PB 0.63

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
1.444	0.379	-2.397	86.90	1.328	-8.726	-1.593	3.278	-2.962	805.5

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.883	13.02	20.33	110.0	32.15	14.78	11.98	9.900	15.58	805.5

B07Q04 S1B TIM = 60 12/08/92 10:06:30AM Model # 2

ASSAYS:CR 0.000 FE 94.18 CU 0.000 ZN 0.000 AS 1.954 PB 0.00

STDEVS:CR 1.969 FE 1.649 CU 1.638 ZN 1.075 AS 1.261 PB 0.66

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
-0.517	2.245	-2.008	94.18	1.100	-8.538	-1.572	1.954	-1.934	813.6

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.533	14.13	22.42	117.2	33.52	15.17	12.32	10.58	16.92	813.6

B07Q06 S1B TIM = 60 12/08/92 10:15:11AM Model # 2

ASSAYS:CR 0.000 FE 99.21 CU 0.000 ZN 0.000 AS 0.761 PB 0.00

STDEVS:CR 1.963 FE 1.680 CU 1.650 ZN 1.084 AS 1.247 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
1.952	-1.175	-0.628	99.21	1.546	-8.937	-1.032	0.761	-1.713	805.1

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
9.883	13.53	22.67	122.0	34.50	15.25	12.57	9.633	16.72	805.1

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B07Q09 S1B TIM = 60 12/08/92 10:26:01AM Model # 2

ASSAYS:CR 0.000 FE 119.2 CU 0.000 ZN 0.000 AS 4.409 PB 0.00

STDEVS:CR 2.068 FE 1.801 CU 1.705 ZN 1.079 AS 1.224 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
0.998	1.102	-1.745	119.2	2.909	-7.435	-2.970	4.409	-3.366	799.2

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.58	15.10	25.12	140.6	39.83	16.30	11.63	10.22	15.62	799.2

B07Q07 S1B TIM = 60 12/08/92 10:32:57AM Model # 2

ASSAYS:CR 0.000 FE 103.3 CU 0.000 ZN 9.692 AS 4.340 PB 0.00

STDEVS:CR 2.011 FE 1.708 CU 1.933 ZN 1.368 AS 1.216 PB 0.63

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
0.966	1.132	-1.937	103.3	2.992	-10.41	9.692	4.340	-3.443	802.5

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.35	14.53	23.50	125.9	37.22	21.32	22.38	10.30	15.42	802.5

B07Q08 S1B TIM = 60 12/08/92 10:39:33AM Model # 2

ASSAYS:CR 2.802 FE 109.0 CU 0.000 ZN 12.03 AS 1.885 PB 0.00

STDEVS:CR 2.055 FE 1.749 CU 1.912 ZN 1.373 AS 1.243 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
4.362	-5.131	2.802	109.0	2.807	-13.24	12.03	1.885	-2.088	804.8

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.47	14.13	25.62	132.2	37.02	20.23	23.20	10.27	16.32	804.8

B07Q10 S1B TIM = 60 12/08/92 10:46:07AM Model # 2

ASSAYS:CR 0.884 FE 101.4 CU 0.000 ZN 0.000 AS 3.210 PB 0.00

STDEVS:CR 1.997 FE 1.697 CU 1.652 ZN 1.067 AS 1.236 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
3.789	-3.243	0.884	101.4	1.355	-7.838	-2.508	3.210	-2.493	807.1

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.68	13.90	23.53	124.4	35.22	15.43	11.78	10.62	16.03	807.1

B07Q11 S1B TIM = 60 12/08/92 10:52:56AM Model # 2

ASSAYS:CR 0.000 FE 108.8 CU 0.000 ZN 0.000 AS 3.471 PB 0.00

STDEVS:CR 2.005 FE 1.738 CU 1.688 ZN 1.088 AS 1.234 PB 0.64

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
0.494	1.577	-2.537	108.8	1.919	-7.655	-2.238	3.471	-2.926	806.8

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.12	14.37	23.40	130.8	37.15	16.08	12.20	10.20	16.03	806.8

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B07Q1213 S1B TIM = 60 12/08/92 11:00:15AM Model # 2
 ASSAYS:CR 0.000 FE 112.3 CU 0.000 ZN 0.000 AS 2.694 PB 0.00
 STDEVS:CR 2.053 FE 1.763 CU 1.692 ZN 1.101 AS 1.238 PB 0.65

CHANNEL INTENSITIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
1.970	0.098	-1.064	112.3	3.002	-9.580	-0.578	2.694	-2.618	803.9

CHANNEL PULSE FREQUENCIES: (MODEL 2: B3)

TI	V	CR	FE	NI	CU	ZN	AS	PB	BS
10.90	14.97	24.63	134.4	37.98	15.80	12.85	9.950	16.18	803.9

MODEL 8 Cm²⁴⁴ Source

PACBG1 S1B TIM = 60 12/02/92 01:40:01PM Model # 8

CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)

TI	CR	FE	CU	ZN	HG	AS	BR	PB	BS
32.02	73.48	893.7	117.8	53.78	37.57	47.55	40.38	47.53	794.4

PACBG2 S1B TIM = 60 12/02/92 01:49:19PM Model # 8

CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)

TI	CR	FE	CU	ZN	HG	AS	BR	PB	BS
27.43	67.00	769.4	110.0	53.32	36.62	49.92	42.12	50.43	811.0

PACBG3 S1B TIM = 60 12/02/92 02:00:27PM Model # 8

CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)

TI	CR	FE	CU	ZN	HG	AS	BR	PB	BS
31.10	68.73	833.7	111.5	51.90	36.92	47.72	41.63	48.02	791.8

RUST-A S1B TIM = 60 12/02/92 02:08:31PM Model # 8

CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)

TI	CR	FE	CU	ZN	HG	AS	BR	PB	BS
25.10	60.30	660.9	98.33	52.28	37.18	48.37	43.22	50.85	789.7

B07PY8 S1B TIM = 60 12/02/92 02:16:36PM Model # 8

CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)

TI	CR	FE	CU	ZN	HG	AS	BR	PB	BS
25.75	61.38	656.6	101.1	52.92	37.75	49.95	43.67	51.70	804.1

B07PY9 S1B TIM = 60 12/02/92 02:25:22PM Model # 8

CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)

TI	CR	FE	CU	ZN	HG	AS	BR	PB	BS
25.95	59.90	649.0	101.8	54.60	37.98	51.12	41.47	50.85	810.7

B07PZ1 S1B TIM = 60 12/02/92 02:34:37PM Model # 8

CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)

TI	CR	FE	CU	ZN	HG	AS	BR	PB	BS
24.28	55.53	587.7	97.28	51.45	36.57	48.20	42.62	50.60	802.9

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B07PZ2 S1B TIM = 60 12/02/92 02:45:44PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
25.47 59.20 632.1 100.5 51.85 36.63 52.15 43.47 52.47 808.9

B07PZ3 S1B TIM = 60 12/02/92 02:55:11PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
26.75 63.08 692.6 104.9 53.28 35.90 47.72 42.98 50.27 803.5

B07PZ4 S1B TIM = 60 12/03/92 01:58:26PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
24.27 56.32 567.1 90.97 49.65 36.32 48.53 42.55 51.70 788.8

B07PZ5 S1B TIM = 60 12/03/92 02:05:56PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
24.78 58.35 639.9 99.90 51.42 38.37 49.98 42.55 53.07 808.0

B07PZ6 S1B TIM = 60 12/03/92 02:26:42PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
24.53 59.92 654.6 98.07 50.72 35.17 50.12 41.20 50.85 785.6

B07PZ7 S1B TIM = 60 12/03/92 02:35:34PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
23.27 58.03 589.0 90.90 51.63 36.62 51.13 42.35 51.42 787.3

B07PZ8 S1B TIM = 60 12/03/92 02:43:11PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
24.10 58.45 583.6 92.27 51.70 36.35 50.85 43.38 50.92 808.7

B07PZ9 S1B TIM = 60 12/03/92 02:51:01PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
22.65 57.38 614.1 97.13 51.87 37.33 50.00 44.20 53.67 812.6

B07Q00 S1B TIM = 60 12/03/92 02:59:19PM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
26.40 69.82 807.9 110.8 51.32 35.05 48.58 41.97 49.93 788.0

B07Q01 S1B TIM = 60 12/08/92 09:25:54AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
26.57 60.53 704.5 103.9 53.53 36.50 49.58 42.32 48.70 806.2

B07Q03 S1B TIM = 60 12/08/92 09:32:41AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
26.47 57.00 630.6 97.68 51.30 36.15 48.45 41.15 49.25 805.5

B07Q04 S1B TIM = 60 12/08/92 10:06:30AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
26.25 61.62 665.6 102.8 51.50 35.93 50.83 41.83 52.27 813.6

B07Q06 S1B TIM = 60 12/08/92 10:15:11AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
26.78 62.28 692.5 101.7 53.17 35.33 47.73 41.70 50.32 805.1

B07Q09 S1B TIM = 60 12/08/92 10:26:01AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
29.58 67.65 804.9 114.1 51.72 34.85 50.77 43.35 47.45 799.2

B07Q07 S1B TIM = 60 12/08/92 10:32:57AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
27.40 65.68 724.8 123.4 92.85 47.08 50.47 41.87 49.58 802.5

B07Q08 S1B TIM = 60 12/08/92 10:39:33AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
28.57 67.90 754.3 122.6 92.98 47.88 52.15 41.68 50.37 804.8

B07Q10 S1B TIM = 60 12/08/92 10:46:07AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
27.78 62.52 704.0 104.1 52.62 38.05 52.65 41.38 49.82 807.1

B07Q11 S1B TIM = 60 12/08/92 10:52:56AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
28.08 64.18 743.4 107.8 53.17 37.98 49.68 43.25 50.62 806.8

B07Q1213 S1B TIM = 60 12/08/92 11:00:15AM Model # 8
CHANNEL PULSE FREQUENCIES: (MODEL 8: BSCAN10)
TI CR FE CU ZN HG AS BR PB BS
30.08 68.63 763.5 109.5 51.88 36.53 49.88 41.23 49.98 803.9

93127330532

MODEL 10 Cm²⁴⁴ Source

PACBG1 S1B TIM = 60 12/02/92 01:40:01PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
136.6	823.7	193.3	111.6	404.1	444.5	794.4

PACBG2 S1B TIM = 60 12/02/92 01:49:19PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
122.2	707.8	179.6	113.7	438.0	505.6	811.0

PACBG3 S1B TIM = 60 12/02/92 02:00:27PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
128.9	769.3	182.3	110.3	413.6	453.9	791.8

RUST-A S1B TIM = 60 12/02/92 02:08:31PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
108.8	607.6	163.5	111.8	427.7	477.2	789.7

B07PY8 S1B TIM = 60 12/02/92 02:16:36PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
111.7	602.0	166.4	114.7	451.2	505.1	804.1

B07PY9 S1B TIM = 60 12/02/92 02:25:22PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
110.1	595.4	167.7	116.1	440.0	496.7	810.7

B07PZ1 S1B TIM = 60 12/02/92 02:34:37PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
102.0	539.3	158.6	111.1	432.9	488.8	802.9

B07PZ2 S1B TIM = 60 12/02/92 02:45:44PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
109.4	577.4	165.9	115.4	453.3	500.6	808.9

B07PZ3 S1B TIM = 60 12/02/92 02:55:11PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
116.0	635.3	172.6	110.3	425.4	476.4	803.5

B07PZ4 S1B TIM = 60 12/03/92 01:58:26PM Model # 10

CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
102.7	518.1	151.0	110.7	431.7	481.7	788.8

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9 3 1 2 7 3 3 0 6 3 4

B07PZ5 SIB TIM = 60 12/03/92 02:05:56PM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 106.6 588.5 163.0 114.4 450.1 504.5 808.0
 B07PZ6 SIB TIM = 60 12/03/92 02:26:42PM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 107.8 602.3 161.4 110.8 401.8 437.9 785.6
 B07PZ7 SIB TIM = 60 12/03/92 02:35:34PM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 104.4 540.6 150.8 114.1 425.0 470.2 787.3
 B07PZ8 SIB TIM = 60 12/03/92 02:43:11PM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 105.2 533.7 154.1 113.6 445.5 506.4 808.7
 B07PZ9 SIB TIM = 60 12/03/92 02:51:01PM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 102.4 565.1 158.4 114.2 454.2 512.6 812.6
 B07Q00 SIB TIM = 60 12/03/92 02:59:19PM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 125.4 743.8 179.5 109.5 414.7 453.2 788.0
 B07Q01 SIB TIM = 60 12/08/92 09:25:54AM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 112.6 647.7 171.7 113.4 439.3 497.3 806.2
 B07Q03 SIB TIM = 60 12/08/92 09:32:41AM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 106.7 577.0 162.8 110.7 431.8 487.2 805.5
 B07Q04 SIB TIM = 60 12/08/92 10:06:30AM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 112.6 611.9 166.8 112.7 450.0 509.1 813.6
 B07Q06 SIB TIM = 60 12/08/92 10:15:11AM Model # 10
 CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)
 TI FE CU AS PB PU BS
 113.4 636.7 169.1 109.6 439.0 486.0 805.1

X-Met Data Output

December 10, 1992

B07Q09 S1B TIM = 60 12/08/92 10:26:01AM Model # 10
CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
125.1	742.0	183.3	112.8	416.6	456.1	799.2

B07Q07 S1B TIM = 60 12/08/92 10:32:57AM Model # 10
CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
119.1	666.0	220.0	136.1	432.3	474.6	802.5

B07Q08 S1B TIM = 60 12/08/92 10:39:33AM Model # 10
CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
122.6	695.0	220.0	137.8	434.1	474.2	804.8

B07Q10 S1B TIM = 60 12/08/92 10:46:07AM Model # 10
CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
116.7	645.2	172.0	117.1	433.3	495.5	807.1

B07Q11 S1B TIM = 60 12/08/92 10:52:56AM Model # 10
CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
118.6	684.6	177.0	113.4	432.7	484.1	806.8

B07Q1213 S1B TIM = 60 12/08/92 11:00:15AM Model # 10
CHANNEL PULSE FREQUENCIES: (MODEL10: BSCAN)

TI	FE	CU	AS	PB	PU	BS
125.7	702.3	179.2	112.0	424.4	470.9	803.9

MODEL 21 Cm²⁴⁴ Source

PACBG1 S1B TIM = 60 12/02/92 01:40:01PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
86.35	987.8	110.5	115.4	366.3	451.1	794.4

PACBG2 S1B TIM = 60 12/02/92 01:49:19PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
77.32	853.7	108.9	118.9	398.9	512.2	811.0

PACBG3 S1B TIM = 60 12/02/92 02:00:27PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
83.02	920.8	106.6	116.4	374.7	460.5	791.8

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RUST-A S1B TIM = 60 12/02/92 02:08:31PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
70.17	735.1	105.6	117.9	387.9	482.9	789.7

B07PY8 S1B TIM = 60 12/02/92 02:16:36PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
73.00	731.6	106.6	121.1	411.1	511.0	804.1

B07PY9 S1B TIM = 60 12/02/92 02:25:22PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
71.35	724.2	109.0	120.4	400.9	503.3	810.7

B07PZ1 S1B TIM = 60 12/02/92 02:34:37PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
66.75	658.1	103.8	117.9	394.4	494.6	802.9

B07PZ2 S1B TIM = 60 12/02/92 02:45:44PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
69.45	706.9	105.0	122.6	413.3	507.4	808.9

B07PZ3 S1B TIM = 60 12/02/92 02:55:11PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
74.55	771.4	108.6	116.1	386.0	482.6	803.5

B07PZ4 S1B TIM = 60 12/03/92 01:58:26PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
66.17	635.2	99.60	117.4	392.2	488.0	788.8

B07PZ5 S1B TIM = 60 12/03/92 02:05:56PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
69.05	712.9	105.5	120.8	410.3	511.5	808.0

B07PZ6 S1B TIM = 60 12/03/92 02:26:42PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
69.62	727.6	103.3	116.9	363.8	443.8	785.6

B07PZ7 S1B TIM = 60 12/03/92 02:35:34PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
67.70	656.9	100.8	120.7	385.5	476.6	787.3

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B07PZ8 S1B TIM = 60 12/03/92 02:43:11PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
68.08	652.3	102.6	120.4	405.1	512.8	808.7

B07PZ9 S1B TIM = 60 12/03/92 02:51:01PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
65.18	687.4	103.4	121.6	413.0	519.3	812.6

B07Q00 S1B TIM = 60 12/03/92 02:59:19PM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
77.48	895.8	104.9	116.6	374.4	459.9	788.0

B07Q01 S1B TIM = 60 12/08/92 09:25:54AM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
72.20	782.7	107.2	118.8	400.4	504.1	806.2

B07Q03 S1B TIM = 60 12/08/92 09:32:41AM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
69.63	703.1	103.2	116.1	393.3	494.2	805.5

B07Q04 S1B TIM = 60 12/08/92 10:06:30AM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
73.22	743.5	105.0	118.4	410.8	515.8	813.6

B07Q06 S1B TIM = 60 12/08/92 10:15:11AM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
73.53	770.6	105.5	114.9	399.9	492.6	805.1

B07Q09 S1B TIM = 60 12/08/92 10:26:01AM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
80.68	892.3	108.4	119.4	376.8	462.4	799.2

B07Q07 S1B TIM = 60 12/08/92 10:32:57AM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
77.42	808.9	166.5	125.0	393.7	480.8	802.5

B07Q08 S1B TIM = 60 12/08/92 10:39:33AM Model # 21
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
79.45	839.9	165.5	126.9	395.0	480.6	804.8

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B07Q10 S1B TIM = 60 12/08/92 10:46:07AM Model # 21

CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
74.80	783.0	106.7	122.0	394.2	502.3	807.1

B07Q11 S1B TIM = 60 12/08/92 10:52:56AM Model # 21

CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
76.20	826.6	108.4	119.8	392.8	490.0	806.8

B07Q1213 S1B TIM = 60 12/08/92 11:00:15AM Model # 21

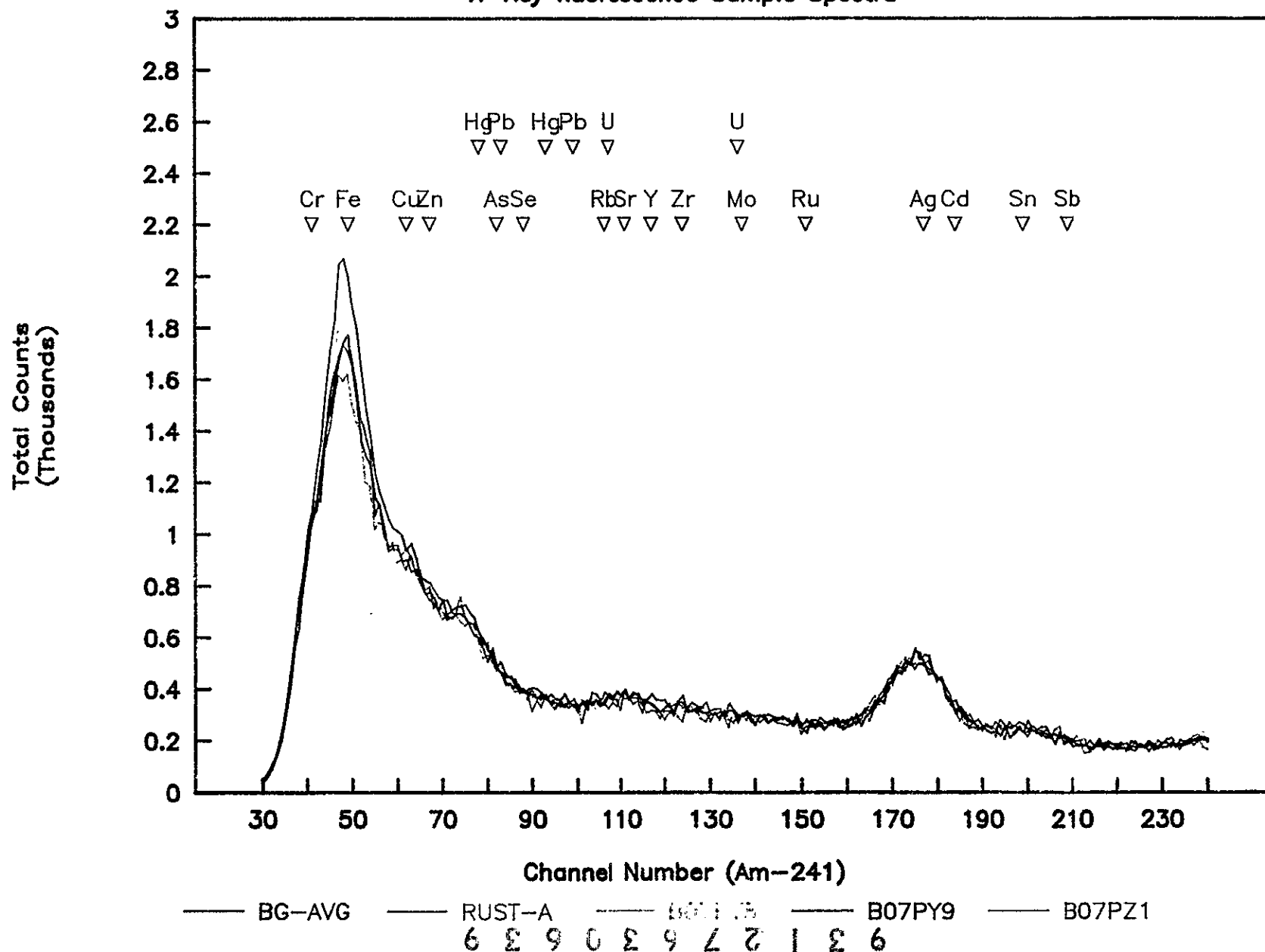
CHANNEL PULSE FREQUENCIES: (MODEL21: BSCAN1)

TI	FE	CU	AS	CM	PU	BS
80.95	849.0	107.7	117.3	386.2	477.2	803.9

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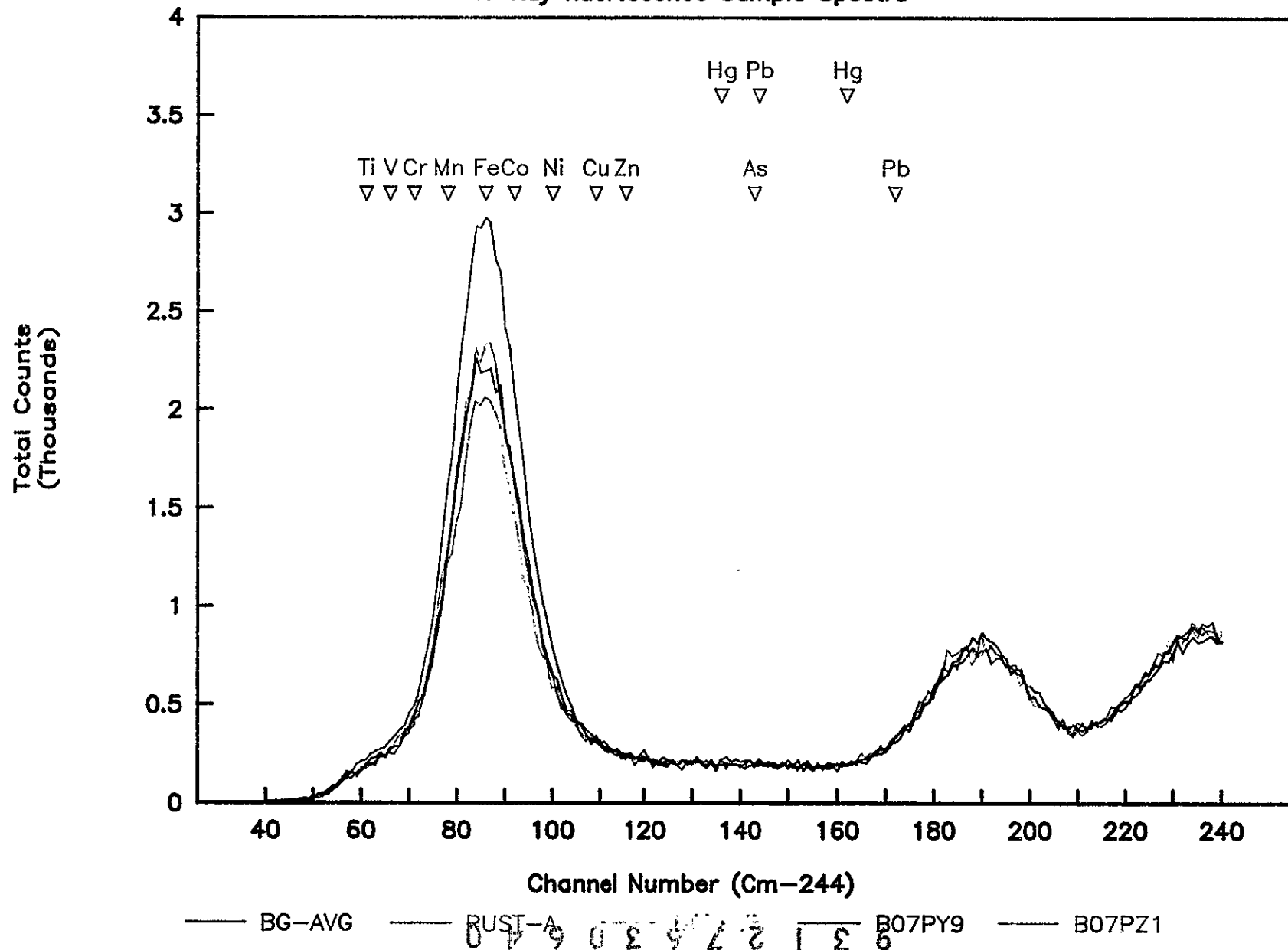
PICKLING ACID CRIB

X-Ray fluorescence Sample Spectra



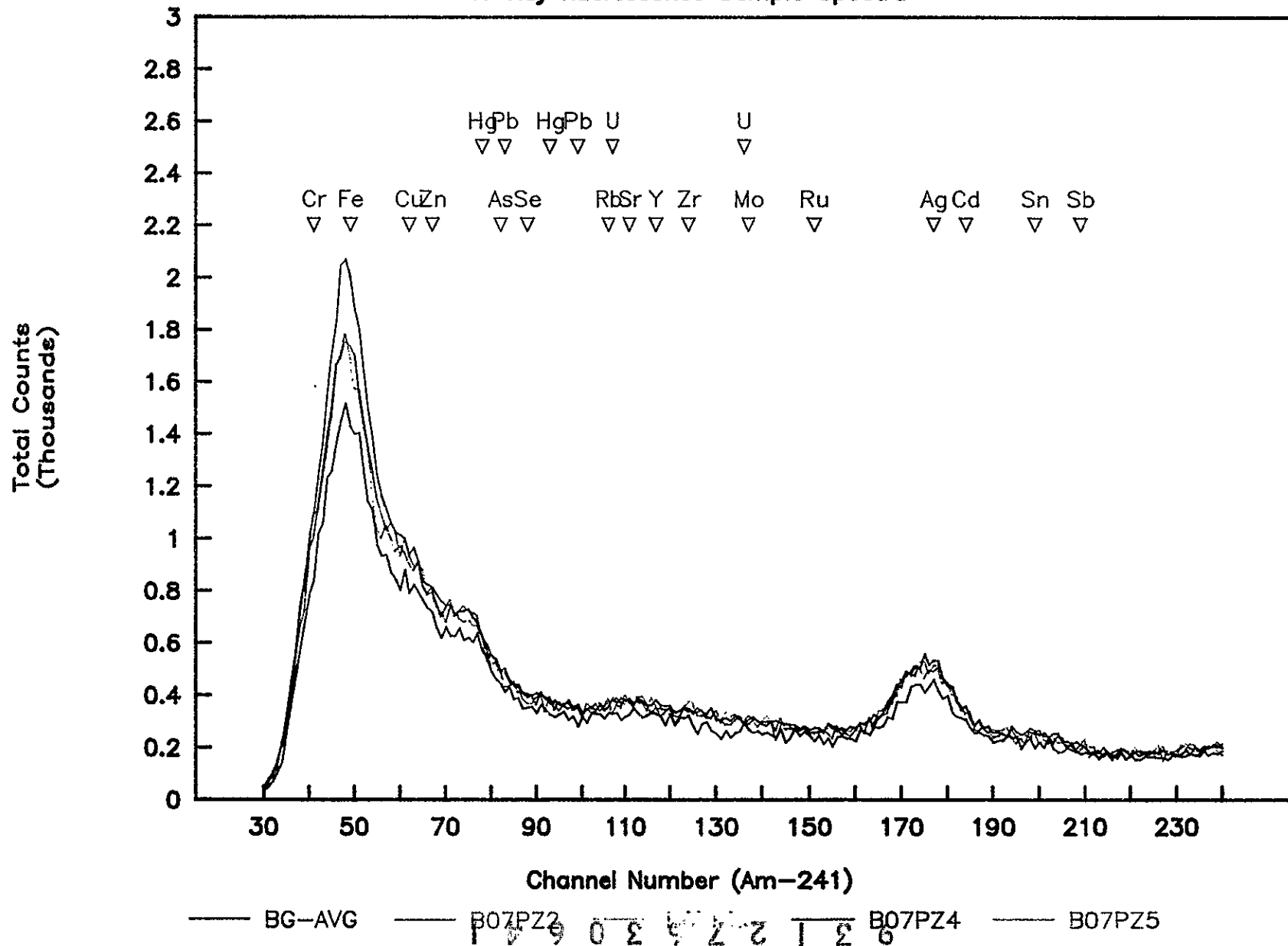
PICKLING ACID CRIB

X-Ray fluorescence Sample Spectra



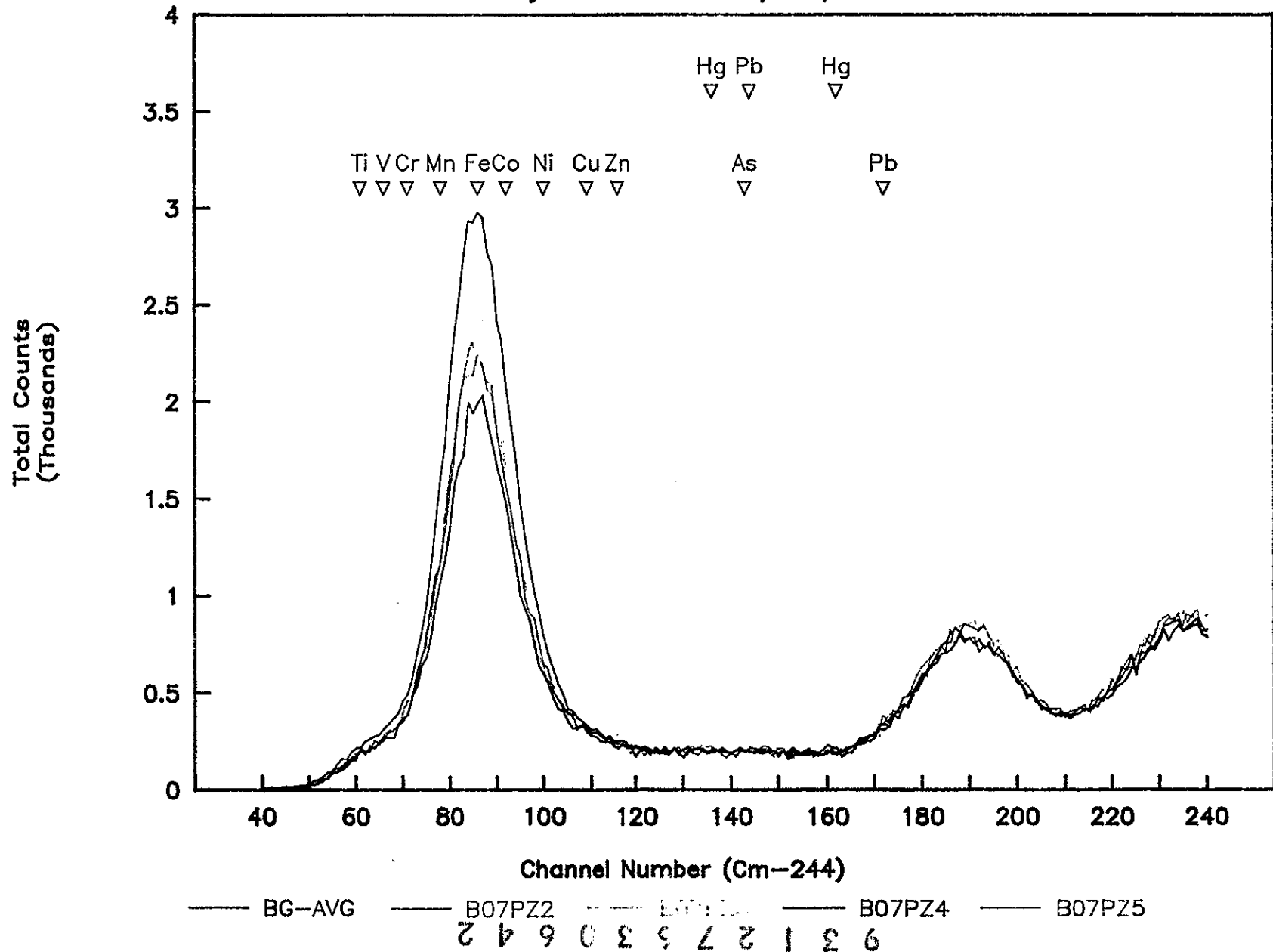
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X-Ray fluorescence Sample Spectra



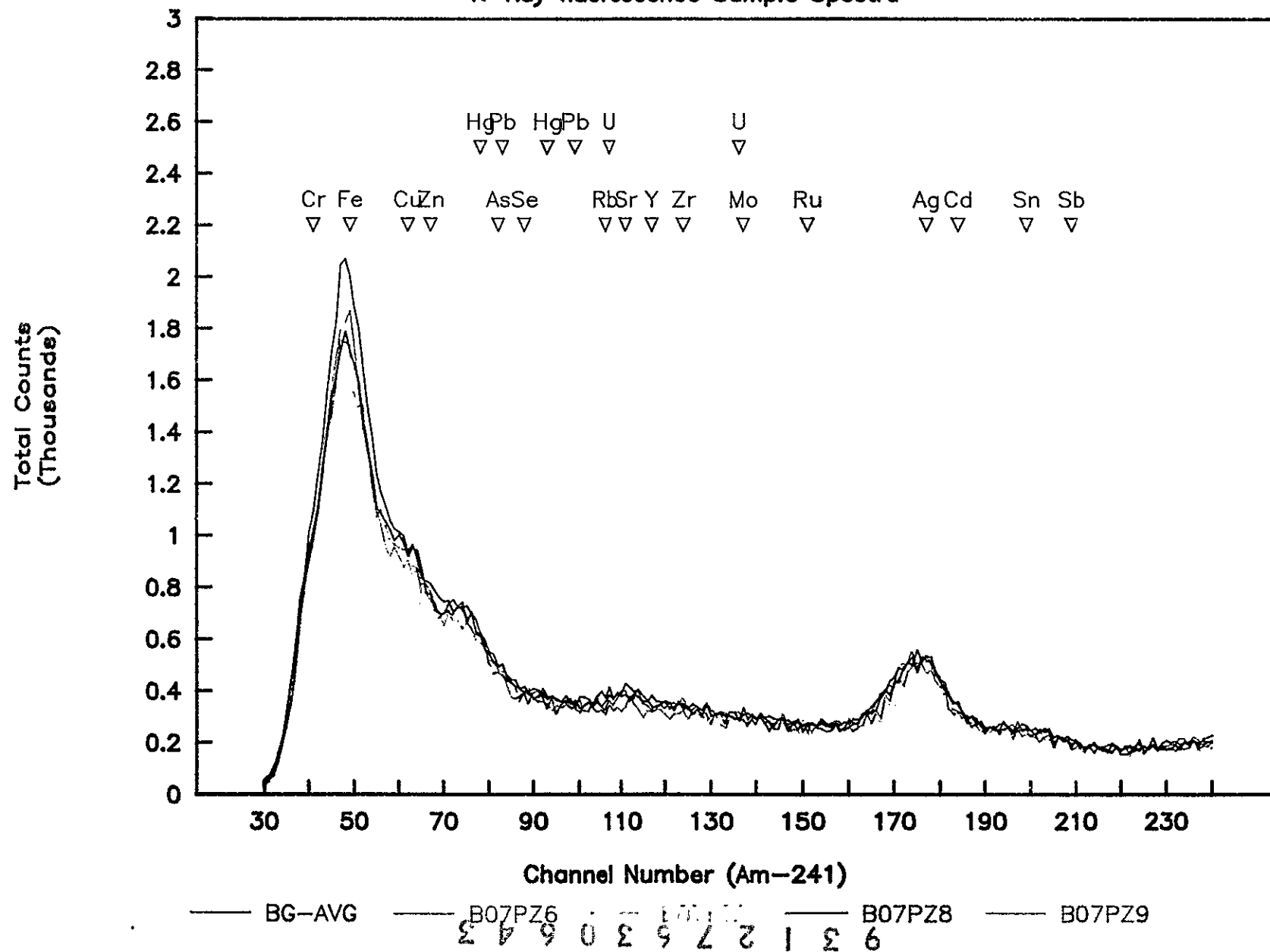
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X-Ray fluorescence Sample Spectra



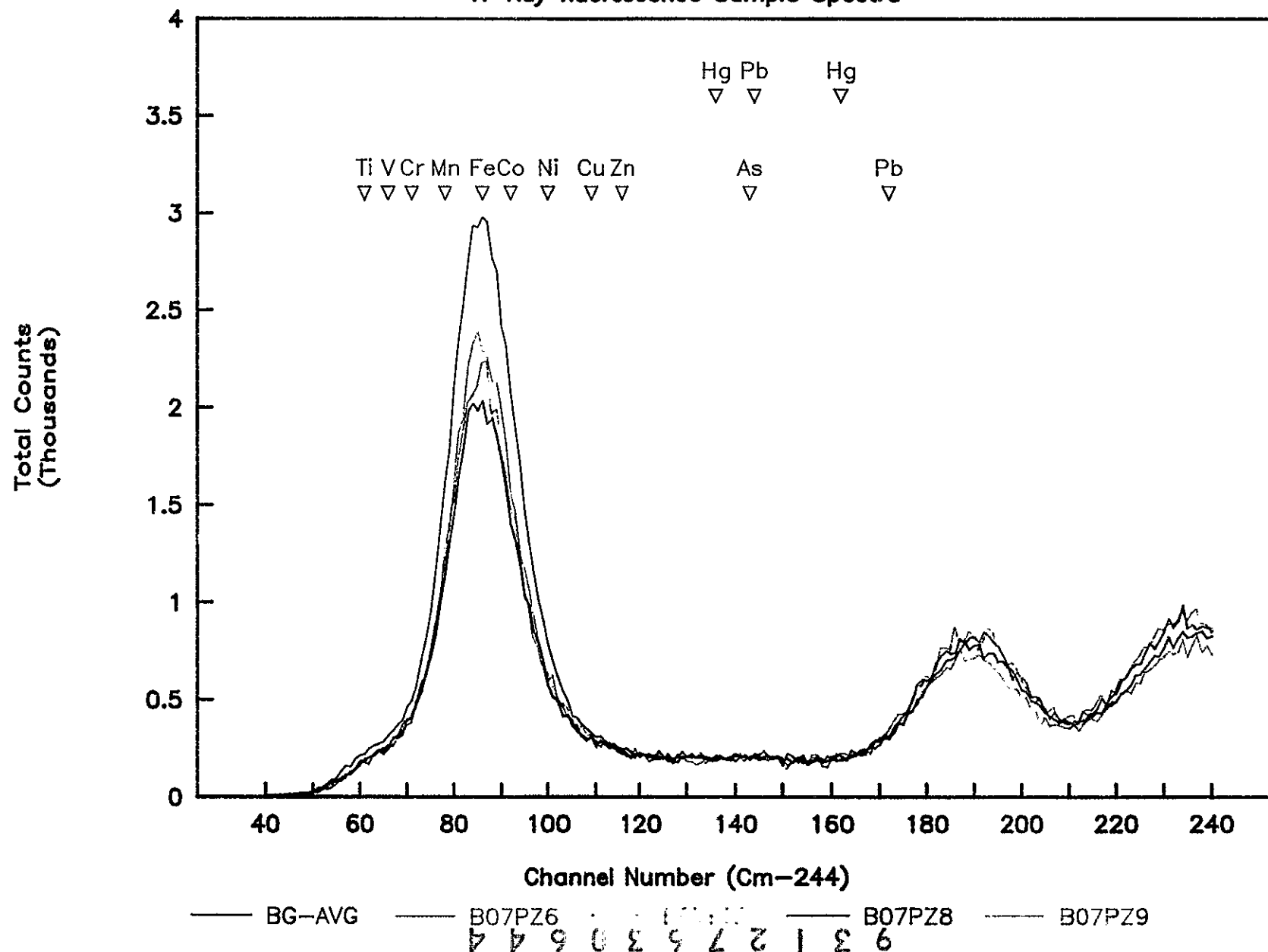
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X-Ray fluorescence Sample Spectra



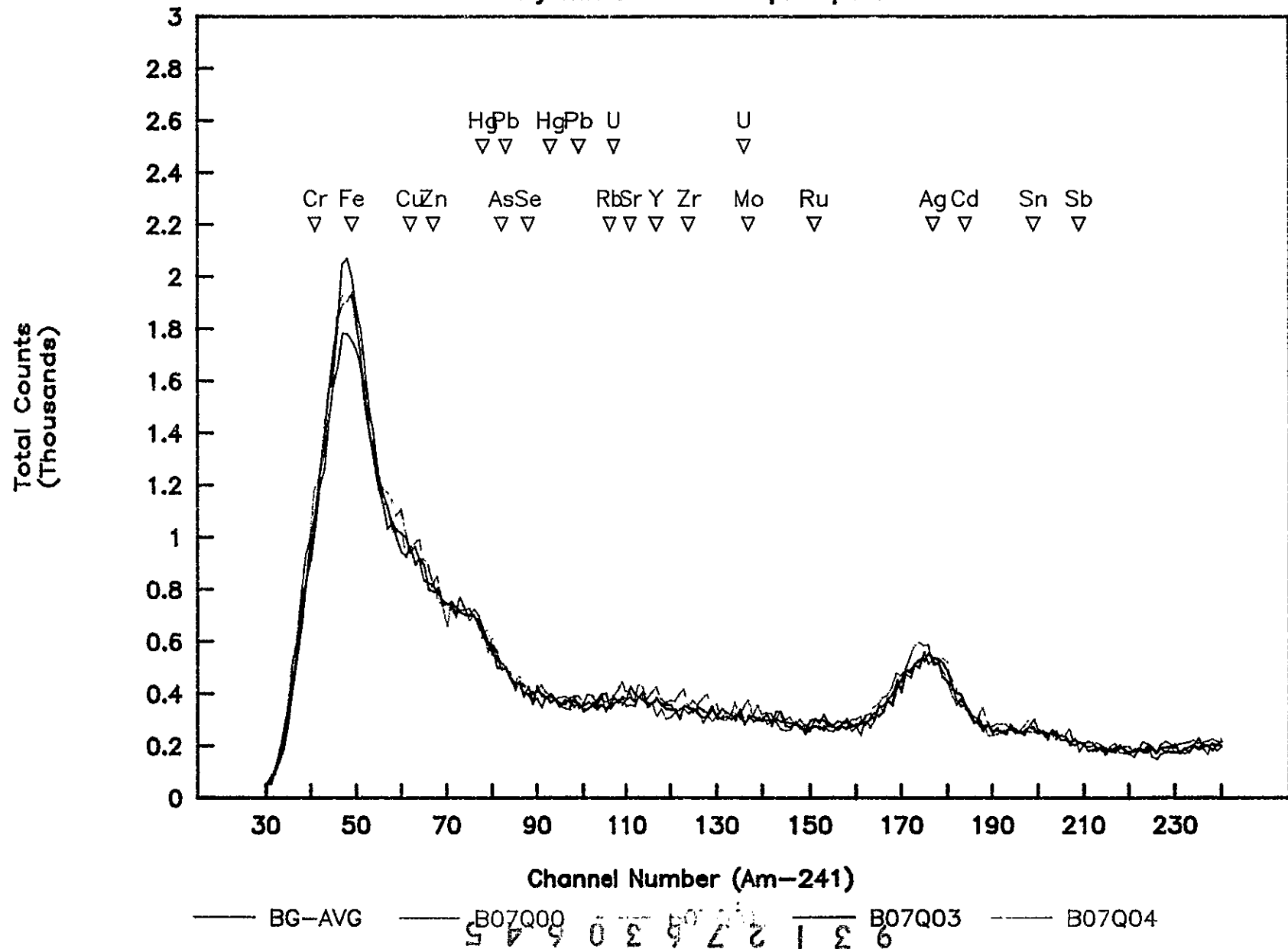
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X-Ray fluorescence Sample Spectra



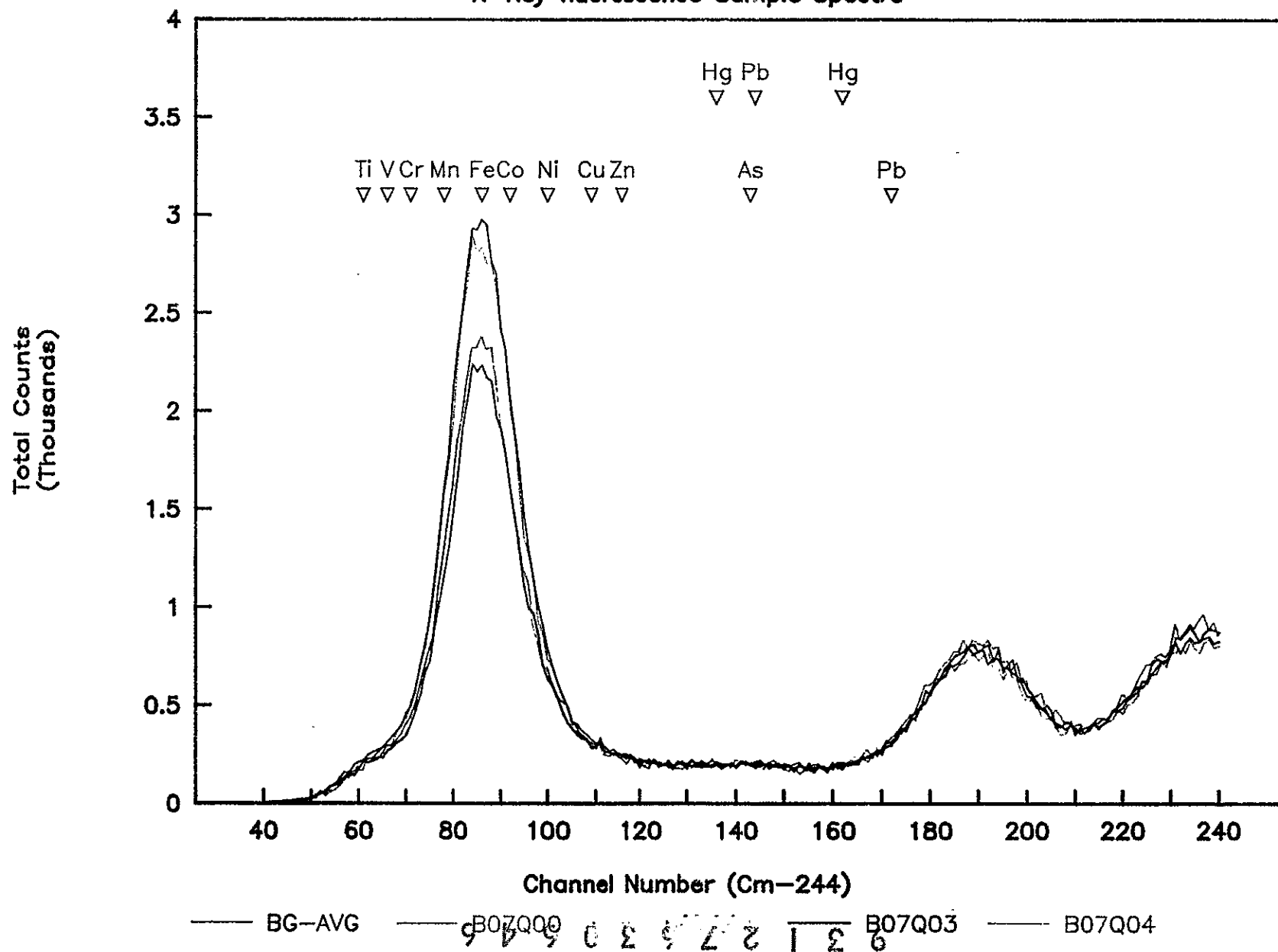
PICKLING ACID CRIB

X-Ray fluorescence Sample Spectra



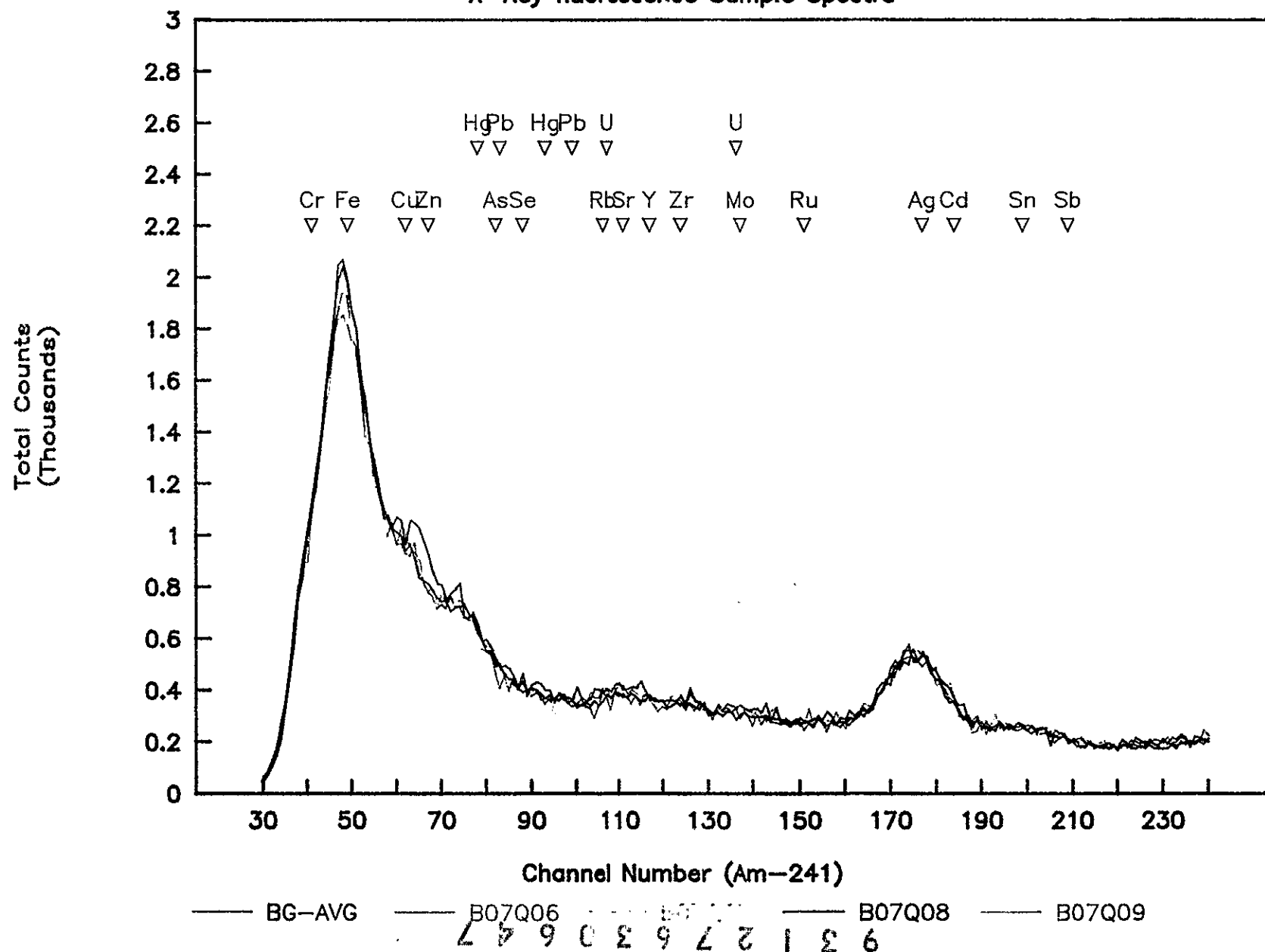
PICKLING ACID CRIB

X-Ray fluorescence Sample Spectra



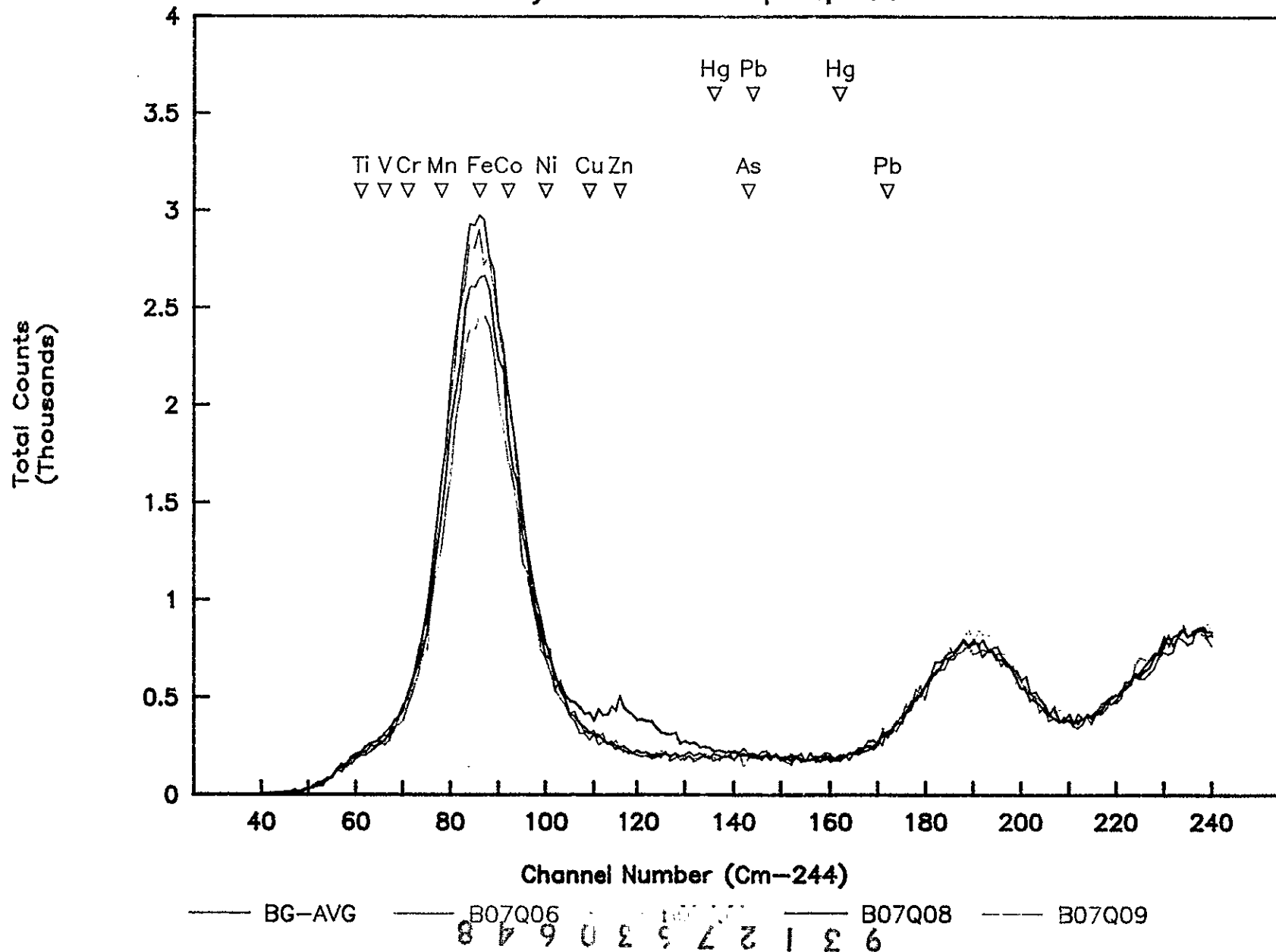
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X-Ray fluorescence Sample Spectra



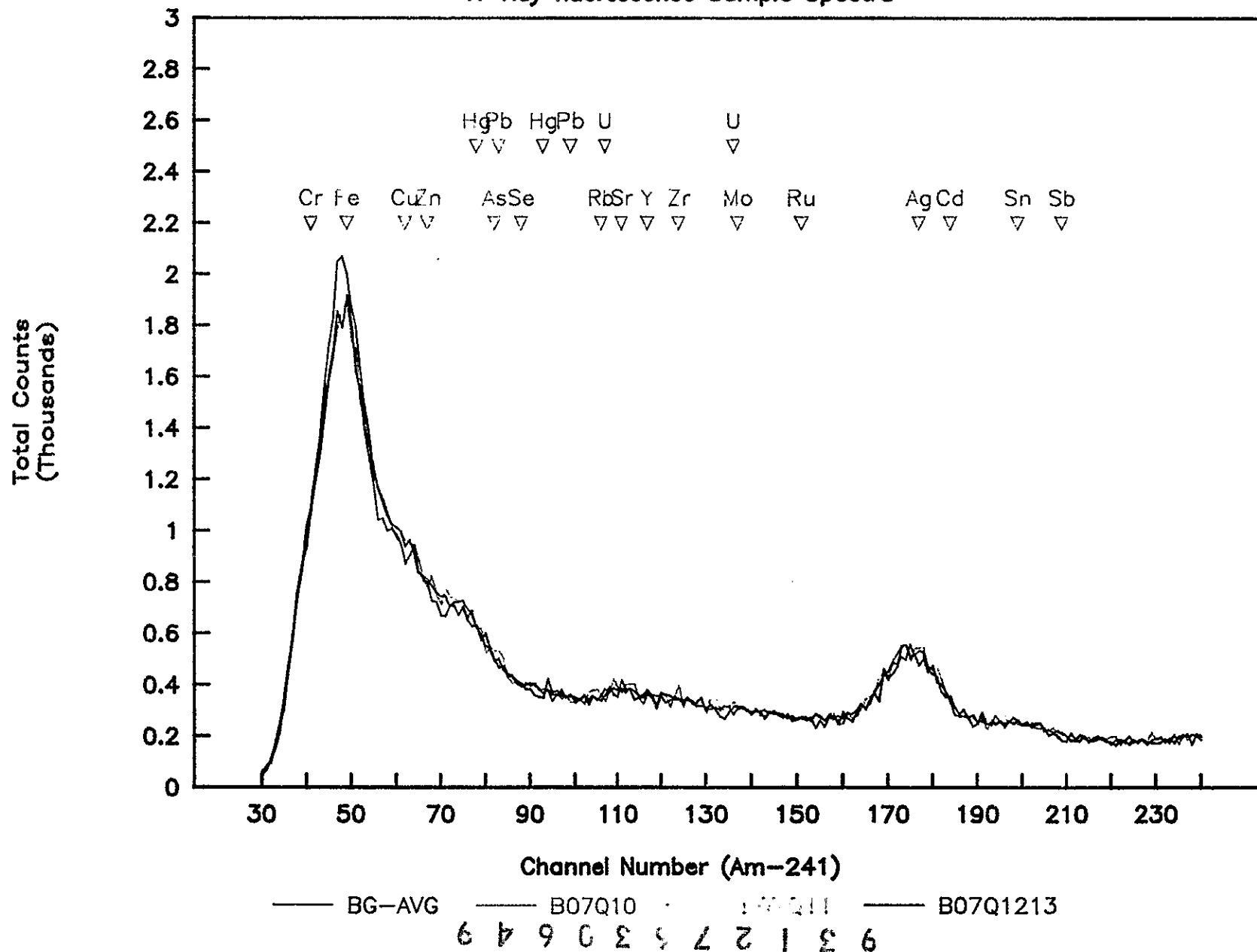
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X-Ray fluorescence Sample Spectra



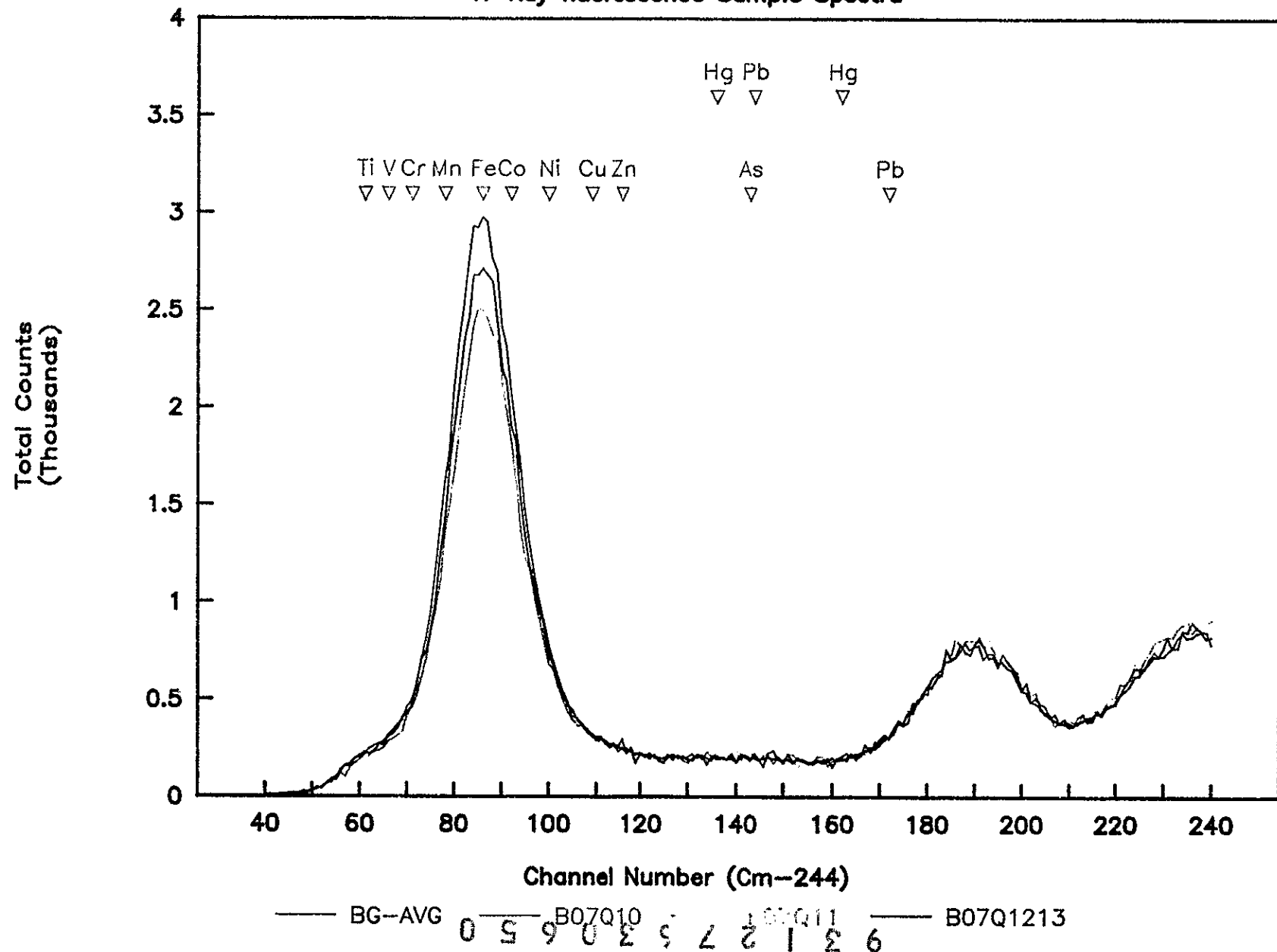
PICKLING ACID CRIB

X-Ray fluorescence Sample Spectra



PICKLING ACID CRIB

X-Ray fluorescence Sample Spectra



N-SPRINGS EXPEDITE RESPONSE ACTION

ERA PROJECT PLAN

ERA PROPOSAL

ERA PROPOSAL PREPARATION

MHC REVIEW

DOE REVIEW

REGULATORY REVIEW

PUBLIC REVIEW

ERA TPA ACTION MEMORANDUM

ERA DESIGN

ADDITIONAL DATA COLLECTION

TREATMENT TESTING

MODELING/ANALYSIS

SYSTEM DESIGN

CONSTRUCT. CONSTRUCTOR PROCLURE

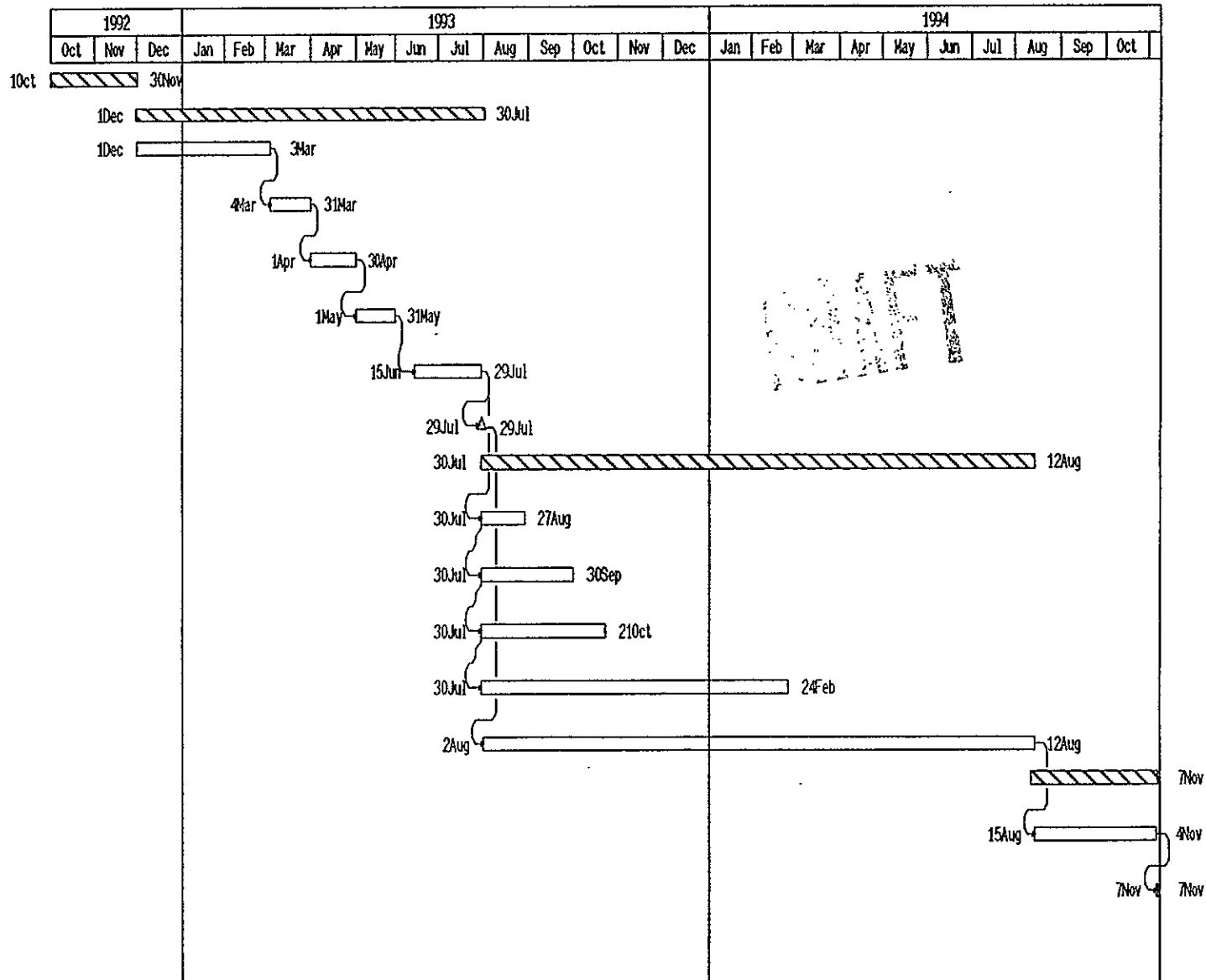
ERA CONSTRUCT/IMPLEMENT

EQUIPMENT PROCUREMENT

FIELD INSTALLATION (1)

SHUTDOWN/STARTUP (2)

SYSTEM OPERATION/ASSESSMENT



1. Duration are unknown, but will be defined in the EPA Proposal.

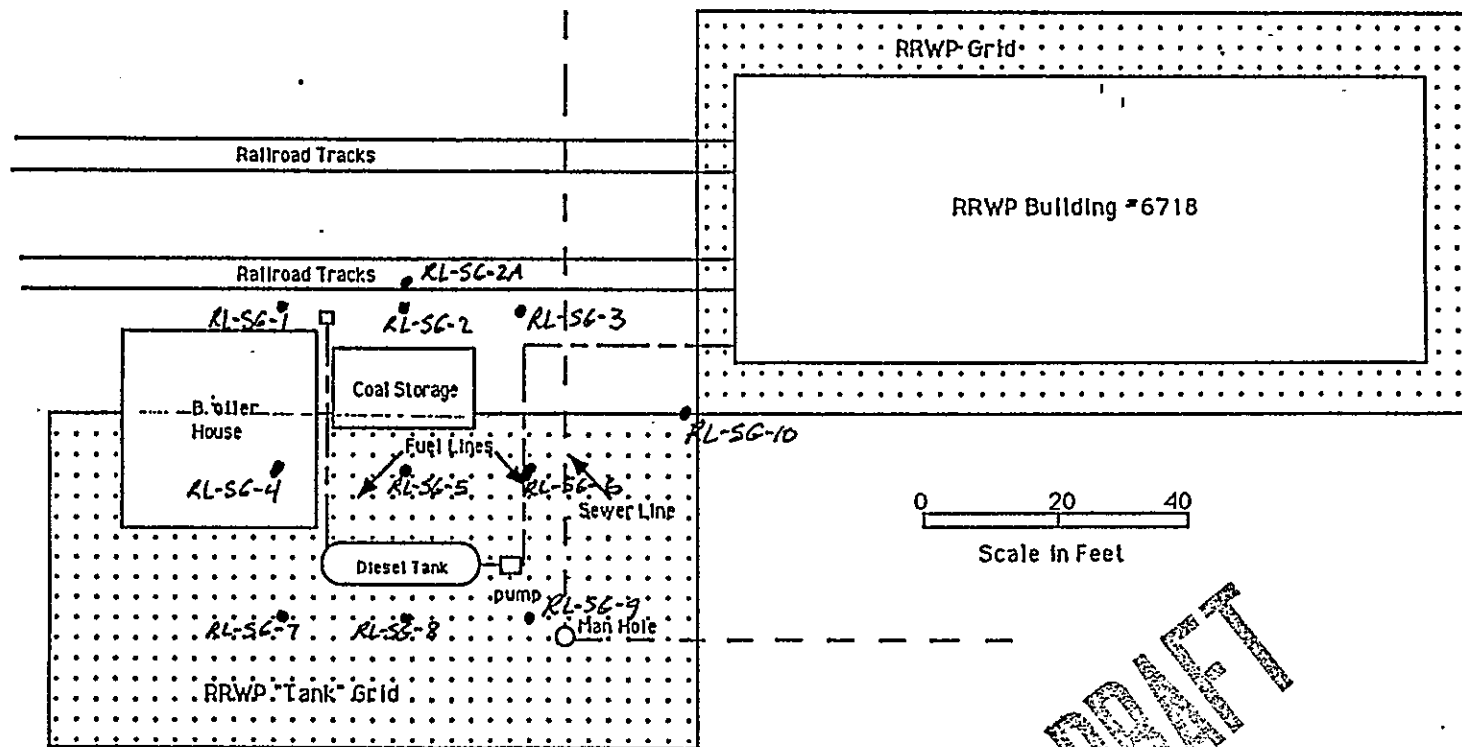
2. Date and duration are unknown, but will be defined in the EPA Proposal

Project: FGNSPRG Date: 4 Dec 92 11:43

N-SPRINGS EXPEDITE RESPONSE ACTION

Page: 1 Drawn by: Steve J. Sakey 6-3092/740 Stevens

1 5 9 0 2 9 7 2 1 2 6



NOT

(A larger map of the area is being prepared)

Figure 1. Location and Depth of Soil Gas Probes at the Riverland Site.

Riverland ERA Soil Gas Report

December ??, 1992

Table 2. Soil Gas Results for the Riverland ERA Site.

Soil Gas Measurements (ppm-v)

Probe Number	Sample Date	Analysis Date	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	1,2-DCE	1,1,1-TCA	TCE	PCE	1,1,2,2-PCA
RL-SG-1	11/18/92	11/18/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-2	11/18/92	11/18/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-2A	11/18/92	11/18/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-3	11/18/92	11/18/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-4	11/18/92	11/18/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-5	11/18/92	11/18/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-6	11/19/92	11/19/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-7	11/19/92	11/19/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-8	11/19/92	11/19/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-9	11/19/92	11/19/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-10	11/19/92	11/19/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10

Quality Control Samples (ppm-v)

Type of QC Sample	Sample Date	Analysis Date	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	1,2-DCE	1,1,1-TCA	TCE	PCE	1,1,2,2-PCA
Equipment Blank	11/18/92	11/18/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
Standard	11/18/92	11/18/92	5.07	<0.20	<0.20	<0.20	<0.10	1.02	<0.10	<0.10	<0.10
Ambient Air	11/19/92	11/19/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
RL-SG-8 Duplicate	11/19/92	11/19/92	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
Standard	11/19/92	11/19/92	<0.20	<0.20	1.30	<0.20	<0.10	<0.10	<0.10	<0.10	0.27

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